2. HAZARD IDENTIFICATION AND MITIGATION

The OU 7-10 Glovebox Excavator Method Project includes excavation, handling, sizing (when needed), and packaging of waste, samples, and soils. Materials within the waste zone are placed primarily in 55-gal drums and secondarily in 85-gal drums. Operation of the project facilities will present physical, chemical, and radiological hazards to operations personnel, so identification and mitigation of these hazards is imperative to prevent injury or exposure to personnel conducting these activities. The primary objective of this section is to identify existing and anticipated hazards based on project operations and to provide controls to eliminate or mitigate these hazards which includes the following:

- Evaluation of project operations to determine the extent that potential industrial safety, radiological, nonradiological, and physical hazards may affect facility personnel
- Establishment of the necessary monitoring and sampling required to evaluate exposure and contamination levels, determine action levels to prevent exposures, and provide specific actions to be followed if action levels are reached
- Determination of necessary engineering controls, isolation methods, administrative controls, work practices, and (where these measures will not adequately control hazards) PPE to further protect project personnel from hazards.

The purpose of this hazard identification section is to lead the user to an understanding of the occupational safety and health hazards associated with project operational tasks. This will enable project management and safety and health professionals to make effective and efficient decisions related to the equipment, processes, procedures, and the allocation of resources to protect the safety and health of project personnel.

The magnitude of danger presented by these hazards to personnel conducting project operations in the WMF-671 WES, RCS, and PGS is dependent on both the nature of tasks being performed and the proximity of personnel to the waste materials. Engineering controls have been implemented along with administrative controls, work procedures, and PPE to further mitigate potential exposures and hazards.

The following section describes the chemical, radiological, safety, and environmental hazards that personnel may encounter while conducting project operational activities. Hazard mitigation will be accomplished through a combination of designed engineering controls with other work controls (such as technical procedures, work orders, JSA, and Guide [GDE] –6212, "Hazard Mitigation Guide for Integrated Work Control Process"). This hazard mitigation strategy will be used to eliminate or mitigate project hazards in accordance with Program Requirements Document (PRD) -25, "Activity Level Hazard Identification, Analysis, and Control," to the extent possible.

2.1 Chemical and Radiological Hazards and Mitigation

Personnel may be exposed to industrial safety hazards or to radiological, nonradiological, and physical agents while conducting project operations. Designed engineering controls will be implemented along with work procedures, real-time monitoring of contaminants, and project facility-specific hazard training to further mitigate potential hazards and exposures. Formal preplanning (e.g., job walk-down, completion of the hazard profile screening checklists, and prejob briefing checklists), JSAs, and other work controls will be written based on the hazards identified in this HASP, technical procedures, STD-101 (2001), "Integrated Work Control Process," work packages, and operational conditions. These documents will specify specific operational hazard mitigation measures to follow.

The dominant waste forms (see Table 2-1) that will be encountered in the waste zone have been assessed based on an evaluation of shipping records for waste placed in a 40 × 40-ft area, also referred to as the Stage I area, in and near the project excavation area. The results of this assessment are shown in Table 2-1 (see Footnote D). The dominant waste form for this area of OU 7-10 is drums of Series 743 sludge (see Footnote E) containing organics such as cutting oils and carbon tetrachloride. The next significant types of waste are drums containing contaminated combustible materials. Of lesser number are drums of evaporated salts (nitrates) and drums of graphite material (believed to be intact or crushed molds).

Table 2-1. Dominant waste forms in the Stage I (project excavation) area.

Waste Stream	Content Code	Summary Characteristics	Packaging	Estimated Quantity
Series 741 sludge first stage sludge	001	Salt precipitate containing plutonium and americium oxides, depleted uranium, metal oxides, and organic constituents.	40 to 50 lb of Portland cement added to bottom of drum and each of two (inner and outer plastic bags, and the top of the outer bags to absorb any free liquids. Lead sheeting may line inside of the drum as well	3 drums
Series 742 sludge second stage sludge	002	Salt plutonium and americium oxides, metal oxides, and organic constituents.	40 to 50 lb of Portland cement added in layers to absorb any free liquids. Waste is double-bagged and drummed.	27 drums
Series 743 sludge organic setups	003	Organic liquid waste solidified using calcium silicate (paste or grease-like).	30 gal of organic waste mixed with 100 lb calcium silicate. Small quantities (10 to 20 lb) of Oil-Dri added to top/bottom of drum, if necessary. Double-bagged.	379 drums
Series 744 sludge special setups	004	complexing chemicals (liquids) including Versenes, organic acids and alcohols solidified with cement.	190 lb of Portland cement and 50 lb of magnesia cement in drum followed by the addition of 26.5 gal of liquid waste. Additional cement top and bottom. Double-bagged.	2 drums
Series 745 sludge evaporator salts	005	Salt residue from evaporated liquids from solar ponds containing 60% sodium nitrate, 30% potassium nitrate, and 10% miscellaneous.	Salt residue packaged in plastic bag and drum. Cement added to damp or wet salt, when necessary.	42 drums
Noncombustible waste	480	Various miscellaneous waste (e.g., gloveboxes, lathes, ducting, piping, angle iron, electronic instrumentation, pumps, motors, power tools, hand tools, chairs, desks).	Varies by process line generating the waste. Wastes may have been wrapped in plastic and/or placed directly into the waste container.	28 drums
Combustible waste	330	Dry combustible materials (e.g., paper, rags, plastics, surgeons' gloves, cloth coveralls and booties, cardboard, wood, wood filter frames, polyethylene bottles).	Varies by process line generating the waste. Plastic bags used in some instances, but in other instances waste placed directly into waste container.	260 drums
Graphite	300	Graphite mold pieces after excess plutonium removal. Molds are broken into large pieces before packaging.	Drums lined with polyethylene bags and, most likely, a cardboard liner.	22 drums
Empty 55-gal drums	No code	Empty drums that originally held lathe coolant at Rocky Flats Plant. Some drums may contain residues.	Single drum placed in cardboard carton.	544 drums

Several tables are presented in this section that identify the potential hazards that may be encountered during project operations based on known waste inventory and operational activities, which state the associated monitoring methods and other hazard-specific mitigation measures. These tables are listed below:

- Table 2-2: Total activities for radiological contaminants in OU 7-10
- Table 2-3: Chemical inventory for OU 7-10 and the Stage I area
- Table 2-4: Evaluation of chemicals and potential agents that may be encountered
- Table 2-5: Summary of project operational activities, associated hazards, and mitigation.

2.1.1 Routes of Exposure

Exposure pathways exist for radiological and nonradiological contaminants that will be encountered during project operations. Engineering controls, monitoring, training, and work controls will mitigate potential contact and uptake of these hazards to a large extent; however, the potential for exposure still exists. Exposure pathways include those listed below:

- **Inhalation** of radiological and nonradiological contaminated soil or fugitive dusts during waste handling and sorting, packaging, or decontamination tasks. Inhalable or respirable (dependent on the particle aerodynamic diameter) fugitive dusts may have trace amounts of radiological or nonradiological contaminants associated with them, resulting in potential respiratory tract deposition.
- **Skin absorption and contact** with radiological and nonradiological contaminated soil or surfaces during waste handling and sorting, packaging, decontamination, or system maintenance tasks. Radiological and nonradiological contaminants can be absorbed through broken skin or by solvent action, resulting in uptake, and skin contamination or irritation.
- **Ingestion** of radiological and nonradiological contaminated soil or materials adsorbed to fugitive dust particles or waste residues, resulting in potential uptake of contaminants into the upper respiratory tract or directly into the through the gastrointestinal (GI) tract (placing contaminated surfaces in mouth) that may result in GI irritation, internal tissue irradiation, or deposition to target organs.
- **Injection** of radiological and nonradiological contaminated materials by breaking of the skin or migration through an existing wound, resulting in localized irritation, contamination, uptake of soluble contaminants, and deposition of insoluble contaminants.

Chemical and radiological hazards will be eliminated, isolated, or mitigated to the extent possible during all project operations. Where these hazards cannot be eliminated or isolated through engineering controls, monitoring for chemical and radiological hazards will be conducted (as described in Section 3) to detect and quantify exposures. Additionally, administrative controls, training, work procedures, and protective equipment will be used to further reduce the likelihood of exposure to these hazards through the routes of entry listed above. Table 2-5 summarizes each primary operational activity, associated hazards, and mitigation procedures.

Table 2-2. Total activities for radiological contaminants in Operable Unit 7-10 decayed to 34 years (1969–2003) using RadDecay.[a, b]

Radionuclide	Ci	Half-Life (Year)	34-Year Decay Activity (1969 to 2003) (Ci)
Am-241	3.2E+03	4.32E+02	3.5E+03
Ba-137m	5.8E-01	4.80E-05	2.5E-01
C-14	3.4E-04	5.73E+03	3.4E-04
Ce-144	4.2E-01	7.80E-01	0
Co-58	3.0E-03	1.94E-01	0
Co-60	1.2E+00	5.27E+00	1.4E-02
Cr-51	5.9E-01	7.59E-03	0
Cs-137	5.8E-01	3.02E+01	2.7E-01
Eu-154	8.8E-07	8.80E+00	6.0E-08
Eu-155	3.0E-03	2.73E+00	2.6E-05
Fe-55	1.1E+00	2.73E+00	5.0E-04
Mn-54	5.0E-03	8.57E-03	0
Nb-95	6.4E-02	9.75E-02	0
Ni-59	1.7E-04	7.60E+04	1.7E-04
Ni-63	1.3E-01	1.00E+02	1.0E-01
Pr-144	4.2E-01	3.30E-05	0
Pu-238	5.0E+01	8.77E+01	3.8E+01
Pu-239	1.7E+03	2.41E+04	1.7E+03
Pu-240	3.9E+02	6.56E+03	3.9E+02
Pu-241	1.1E+04	1.44E+01	2.1E+03
Pu-242	2.0E-02	3.75E+05	2.0E-02
Ru-106	2.1E-01	1.01E+00	0
Rh-106	2.1E-01	9.50E-07	0
Sb-125	9.1E-02	2.77E+00	1.8E-05
Sr-90	3.5E-01	2.86E+01	1.5E-01
Tc-99	5.5E-05	2.13E+05	5.5E-05
U-234	7.5E-01	2.46E+08	7.5E-01
U-235	5.3E-02	7.04E+08	5.3E-02
U-238	4.0E+00	4.47E+09	4.0E+00
Y-90	3.5E-01	1.20E-04	1.5E-01
Zr-95	6.4E-02	1.75E-02	0

a. "RadDecay for Windows" is Software Version 1.13 from Grove (1995).
b. (Einerson and Thomas 1999)

Table 2-3. Chemical inventory for Operable Unit 7-10 and the Stage I area.

Chemical	Content Code	OU 7-10 Inventory (g)	OU 7-10 Inventory (L)	Stage I Area (g)	Stage I Area (L)
Asbestos	335, 338, 490	4.0E+05	—	—	—
Ascorbic acid	004	1.4E+06	—	6.67E+04	—
Beryllium	001	5.8E+04	—	2.70E+02	—
Beryllium	002	1.9E+04	—	2.59E+03	—
Beryllium (total)	001, 002	7.7E+04	—	2.86E+03	—
Butyl alcohol	001, 002	1.1E+03	1.36E+00	5.25E+01	6.48E-02
Cadmium	001, 002	5.4E+02	—	2.58E+01	—
Carbon tetrachloride	001, 002, 003, 004	9.4E+07	1.54E+04	3.13E+07	5.13E+03
Chloroform	001, 002, 003, 004	1.6E+05	1.07E+02	3.49E+04	2.34E+01
EDTA (assumed to be tetrasodium)	004	1.4E+06	—	6.67E+04	—
Ethyl alcohol	004	1.1E+06	1.39E+03	5.24E+04	6.64E+01
Freon 113	003	8.5E+05	1.42E+02	2.51E+05	4.74E+01
Lead		5.2E+06	—	—	—
Lithium oxide	002	Trace	—	Trace	—
Mercury	002	—[a]	—[a]	—[a]	—[a]
Methyl alcohol	004	2.2E+03	7.51E-01	1.07E+02	3.57E-02
Methyl alcohol	001, 002	2.4E+03	8.01E-01	1.14E+02	3.82E-02
Methyl alcohol (total)	001, 002	4.6E+03	1.55E+00	2.22E+02	7.39E-02
Methylene chloride	001, 002, 003, 004	1.6E+05	1.20E+02	3.49E+04	2.61E+01
Polychlorinated biphenyls (PCBs)	003	Unknown	Unknown	Unknown	Unknown
Potassium chloride	005	1.4E+06	—	2.21E+05	—
Potassium dichromate	005	3.7E+04	—	5.84E+03	—
Potassium cyanide	002	—[b]	—	—[b]	—
Potassium nitrate	005	3.2E+07	—	5.05E+06	—
Potassium phosphate	005	7.7E+05	—	1.22E+05	—
Potassium sulfate	005	1.4E+06	—	2.21E+05	—
Silver	INEEL Waste	1.0E+00	—	—	—
Sodium chloride	005	3.0E+06	—	4.74E+05	—
Sodium dichromate	005	7.8E+04	—	1.23E+04	—
Sodium cyanide	002	—[b]	—	—[b]	—
Sodium nitrate	005	6.50E+07	—	1.03E+07	—
Sodium phosphate	005	1.40E+06	—	2.21E+05	—
Sodium sulfate	005	3.00E+06	—	4.74E+05	—
Tetrachloroethene	003	2.70E+07	4.46E+03	8.98E+06	1.48E+03
1,1,1-Trichloroethane	001, 002, 003, 004	2.20E+07	4.17E+03	7.31E+06	1.39E+03
Trichloroethene	003	2.50E+07	4.52E+03	8.31E+06	1.50E+03
Xylene	001, 002	5.20E+03	5.98E+00	2.48E+02	2.58E-01
Zirconium	INEEL Waste	1.5E+07	—	—	—

a. Clements (1982) reports that pint bottles of mercury were periodically disposed of through the Series 742 sludge waste stream. It is unknown how much, if any, mercury is in OU 7-10 or the OU 7-10 Glovebox Excavator Method Project area. A 1-pt bottle of mercury is assumed to be in the project area.

b. Two 25-lb packs of sodium cyanide or potassium cyanide pellets were distributed in Series 742 sludge waste drums buried in the Subsurface Disposal Area. It is assumed that the cyanide is in the project area.

Table 2-4. Evaluation of chemicals and potential agents that may be encountered.

Material or Chemical (CAS #, Vapor Density and Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (acute and chronic)	Target Organs and System	Carcinogen? (source)[e]	Matrix or Source to Be Encountered During Project Operations
Organic Compounds						
Ascorbic acid (50-81-7)	None established	Ih, Ig	Eye irritation	Mild irritation of eyes only	No	Content Code 004, solid
Butyl alcohol (75-65-0) VD = 2.55 IE = 9.7 eV	TLV: 20 ppm	Ih, Ig, Con	Irritation eyes, skin, nose, throat; drowsiness, narcosis	Eyes, skin, respiratory system, central nervous system	No	Content Codes 001, 002, liquid
Carbon tetrachloride (56-23-5) VD = 5.3 IE-=11.5 eV	TLV: 5 ppm STEL: 10 ppm Ceiling: 25 ppm	Ih, Ig, S, Con	Irritation eyes, skin; central nervous system depression; nausea, vomiting; liver, kidney injury; drowsiness, dizziness, uncoordination; (potential occupational carcinogen)	Central nervous system, eyes, lungs, liver, kidneys, skin	Yes—NIOSH A2-ACGIH	Content Codes 001 through 004, liquid
Chloroform (67-66-3) VD = 4.12 IE = 11.4 eV	TLV: 10 ppm	Ih, Ig, S, Con	Irritation eyes, skin; dizziness, mental dullness, nausea, confusion; headache, lassitude (weakness, exhaustion); anesthesia; enlarged liver; (potential occupational carcinogen)	Liver, kidneys, heart, eyes, skin, central nervous system	No	Content Codes 001 through 004, liquid
Diesel fuel (68476-34-6) VD = 1.0 IE = NA	TLV: 100 mg/m^3 (ACGIH—diesel fuel vapor or aerosol)	Ih, Ig, S, Con	Eye irritation; respiratory system changes; dermatitis	Eye, respiratory system	No	Fuel handling during refueling of excavator and other diesel powered equipment

Table 2-4. (continued).

Material or Chemical (CAS #, Vapor Density and Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (acute and chronic)	Target Organs and System	Carcinogen? (source)[e]	Matrix or Source to Be Encountered During Project Operations
Diesel exhaust (particulate aerodynamic diameter <1 µm)	TLV: 0.02 mg/m^3 (ACGIH 2002)	Ih	Respiratory, nose, throat or lung irritation with stinging and redness of the eyes; headache; nausea; dizziness; unconsciousness	Respiratory system	A2—ACGIH	Exhaust from excavator and other diesel-powered equipment
EDTA (tetrasodium) (64-02-8)	None established	Ig, S	Eye, skin, and mucous membrane irritation	Eyes, skin	No	Content Code 004, solid
Ethyl alcohol (64-17-5) VD = 1.6 IE = 10.47 eV	TLV: 1000 ppm	Ih, Ig, S, Con	Irritation eyes, skin, nose; headache, drowsiness, fatigue, narcosis; cough; liver damage; anemia; reproductive, teratogenic effects.	Eyes, skin, respiratory system, central nervous system, liver, blood, reproductive system	No	Content Code 004, liquid
Freon 113 (76-13-1) VD = 2.9 IE = 11.99 eV	TLV: 1000 ppm STEL: 1250 ppm	Ih, Ig, Con	Irritation skin, throat, drowsiness, dermatitis; CNS depressant and depression (in animals); cardiac arrhythmia, narcosis.	Skin, heart, CNS cardiovascular system	No	Content Code 003, liquid
Methyl alcohol (67-56-1) VD = 1.11 IE = 10.84 eV	TLV: 200 ppm	Ih, Ig, S, Con	Eye, skin, nose and throat irritation; headache; drowsiness; optic nerve atrophy; chest tightness; narcosis	Eyes, skin, respiratory system, CNS	No	Content Codes 001, 002, and 004
Methylene chloride (75-09-2) VD = 2.9 IE = 11.3 eV	TLV: 50 ppm OSHA (29 CFR 1910.1052, "Methylene Chloride," [29 CFR 1910, 2002]) PEL: 25 ppm STEL: 125 ppm	Ih, Ig, S, Con	Eye and skin irritation; fatigue, weakness, somnolence, lightheadedness; numbness, tingle limbs; nausea	Eyes, skin, cardiovascular system, CNS	Yes—NIOSH A3—ACGIH	Content Codes 001 through 004, liquid

Table 2-4. (continued).

Material or Chemical (CAS #, Vapor Density and Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (acute and chronic)	Target Organs and System	Carcinogen? (source)[e]	Matrix or Source to Be Encountered During Project Operations
PCBs not specified (Aroclor-1254 used for toxicological evaluation purposes)	TLV: 0.5 mg/m^3—skin	Ih, Ig, S, Con	Eye irritation; chloracne; liver damage; reproductive effects	Skin, eyes, liver, reproductive system	Yes-NTP Yes-IARC No-OSHA	Content Code 003
Tetrachloroethene (127-18-4) VD = 5.8 IE = 9.3 eV	TLV: 25 ppm STEL: 100 ppm	Ih, Ig, S, Con	Eye, skin, nose, throat, and respiratory system irritation; nausea; flush face, neck; vertigo, dizziness, uncoordination; headache, somnolence; skin erythema; liver damage	Eyes, skin, respiratory system, liver, kidneys, CNS	Yes—NIOSH	Content Code 003, liquid
1,1,1-Trichloroethane (71-55-6) VD = 4.6 IE = 11.1 eV	TLV: 350 ppm STEL: 450 ppm	Ih, Ig, Con	Eye and skin irritation; headache, lassitude, CNS depressant/depression, poor equilibrium; dermatitis; cardiac arrhythmias; liver damage	Eyes, skin, CNS, cardiovascular, liver	No A4—ACGIH	Content Codes 001 through 004, liquids
Trichloroethene (79-01-6) VD = 4.53 IE = 9.5 eV	TLV: 50 ppm STEL: 100 ppm	Ih, Ig, S, Con	Eye and skin irritation; headache, vertigo; visual disturbance, fatigue, giddiness, tremor, somnolence, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury	Eyes, skin, respiratory system, heart, liver, kidneys, CNS	Yes—NIOSH	Content Code 003, liquid
Xylene (total) (95-47-6) VD = 5.2 IE = 8.6 eV	TLV: 100 ppm STEL: 150 ppm	Ih, Ig, S, Con	Headache, loss of appetite, nervousness and pale skin; skin rash; eye damage; damage to bone marrow, causing low blood cell count; liver and kidney damage	Skin, eyes, blood, liver, kidneys	No	Content Codes 001 and 002, liquid

Table 2-4. (continued).

Material or Chemical (CAS #, Vapor Density and Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (acute and chronic)	Target Organs and System	Carcinogen? (source)[e]	Matrix or Source to Be Encountered During Project Operations
Inorganic Compounds						
Asbestos (12001-29-5) VD–NA	TLV: 0.1 fiber/cc PEL: 0.1 fiber/cc Excursion Limit: 1.0 fiber/cc in 30-minutes (29 CFR 1926.1101, "Asbestos," [29 CFR 1910, 2002])	Ih, Ig,Con	Irritation of eyes and skin, chronic asbestosis, restricted pulmonary function	Eyes, respiratory tract, lung lining	A1-ACGIH Yes-NTP Yes-IARC Yes-OSHA	Content Codes 335, 338, and 490
Beryllium (7440-41-7) VD = NA	TLV: 0.002 mg/m^3 STEL: 0.01 mg/m^3	Ih, Con	Berylliosis; anorexia, weight loss, weakness, chest pain, cough, clubbing of fingers, cyanosis, pulmonary insufficiency; irritation eyes; dermatitis	Eyes, skin, respiratory system	Yes-NTP Yes-IARC NO-OSHA	Content Codes 001 and 002, solid
Cadmium (7440-43-9) VD = NA	TLV: 0.01 mg/m^3 Respirable: 0.002 mg/m^3 PEL: 5 µg/m^3 **Action level: 2.5 µg/m^3** (29 CFR 1926.1127, "Cadmium,"[29 CFR 1910, 2002])	Ih, Ig	Pulmonary edema, dyspnea, cough, chest tightness, substernal pain; headache; chills, muscle aches; nausea, vomiting, diarrhea; anosmia , emphysema, proteinuria, mild anemia	Respiratory system, kidneys, prostate, blood	Yes-NTP Yes-IARC A2-ACGIH Yes-OSHA	Content Codes 001 and 002, solid

Table 2-4. (continued).

Material or Chemical (CAS #, Vapor Density and Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (acute and chronic)	Target Organs and System	Carcinogen? (source)[e]	Matrix or Source to Be Encountered During Project Operations
Lead (7439-92-1) VD = NA	TLV: 50 µg/m^3 **OR** A PEL in µg/m^3 equal to 400 divided by the number of hours worked per day for shifts longer than 8 hours. (29 CFR 1926.62, "Lead," [29 CFR 1910, 2002])	Ih, Ig, Con	Weakness, lassitude, insomnia; facial pallor; anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis wrist, ankles; encephalopathy; kidney disease; irritation eyes; hypotension	Eyes, GI, CNS, kidneys, blood, gingival tissue	No	Content Code (unknown), solid
Lithium oxide (12057-24-8) VD = NA	None established	Ih, Ig, Con	Corrosive to eyes, skin, nose and throat	Skin and eyes (corrosive)	No	Content Code 002, solid (trace amounts only)
Mercury	TLV: 0.025 mg/m^3—skin STEL: 0.03 mg/m^3	Ih, Ig, S, Con	Irritation eyes, skin; cough, chest pain, dyspnea, bronchitis pneumonitis; tremor, insomnia, irritability, indecision, headache, fatigue, weakness; stomatitis, salivation; gastrointestinal disturbance, anorexia, weight loss; proteinuria	Eyes, skin, respiratory system, CNS, kidneys	No	Content Code 002, liquid[f]
Potassium chloride (7447-40-7) VD = NA	None established	Ih, Ig, Con	Eyes, irritation of mucous membranes	None identified, primarily a localized irritant	No	Content Code 005, solid

Table 2-4. (continued).

Material or Chemical (CAS #, Vapor Density and Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (acute and chronic)	Target Organs and System	Carcinogen? (source)[e]	Matrix or Source to Be Encountered During Project Operations
Potassium cyanide (150-50-8) VD = NA	PEL: 5 mg/m^3	Ih, Ig, S, Con	Irritation eyes, skin, upper respiratory system; asphyxia; lassitude (weakness, exhaustion), headache, confusion; nausea, vomiting; increased respiratory rate, slow gasping respiration; thyroid, blood changes	Eyes, skin, respiratory system, cardiovascular system, central nervous system, thyroid, blood	No	Content Code 002[g]
Potassium dichromate (7778-50-9) VD = NA	TLV: 0.05 mg/m^3 (chromate)	Ih, Ig, Con (chromate)	Respiratory, eyes, dermis, skin irritation, discoloration, mucous membrane ulcerating, perforated septum (chromate)	Skin (chromate)	Yes-NPT Yes-IARC No-Z List No-OSHA (chromate)	Content Code 005, solid
Potassium nitrate (7757-79-1) VD = NA	None established	Ih, Ig, Con	Respiratory irritation, (Ig—GI pain, nausea and vomiting)	None identified, primarily a localized irritant	No	Content Code 005, solid
Potassium phosphate (7778-77-0) VD = NA	None established	Ih, Ig, Con	Eyes, minor skin irritation	None identified, primarily a localized irritant	No	Content Code 005, solid
Potassium sulfate (7778-80-5) VD = NA	None established	Ih, Ig	None identified	None identified	No	Content Code 005, solid

Table 2-4. (continued).

Material or Chemical (CAS #, Vapor Density and Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (acute and chronic)	Target Organs and System	Carcinogen? (source)[e]	Matrix or Source to Be Encountered During Project Operations
Silver (7440-22-4) VD = NA	TLV: 0.1 mg/m^3 TLV: 0.01 mg/m^3 (soluble compounds as silver)	Ih, Ig, Con	Blue-gray eyes, nasal septum, throat, skin; irritation, ulceration skin; gastrointestinal disturbance	Nasal septum, skin, eyes	No	Content Code INEEL waste, solid
Sodium chloride (7647-14-5) VP-NA	None established	Ih, Ig, Con	Eyes, irritation of mucous membranes	None identified, primarily a localized irritant	No	Content Code 005, solid
Sodium cyanide (143-33-9) VD = NA	PEL: 5 mg/m^3	Ih, Ig, S, Con	Irritation eyes, skin; asphyxia; lassitude (weakness, exhaustion), headache, confusion; nausea, vomiting; increased respiratory rate; slow gasping respiration; thyroid, blood changes	Eyes, skin, cardiovascular system, central nervous system, thyroid, blood	No	Content Code 002[g]
Sodium dichromate (10588-01-9) VD = NA	TLV—0.05 mg/M^3 (chromate)	Ih, Ig, Con (chromate)	Respiratory, eyes, skin irritation or ulcerating (chromate)	Kidneys, liver (chromate)	Yes-NPT Yes-IARC Yes-Z List Yes-OSHA (chromate)	Content Code 005, solid
Sodium nitrate (7631-99-4) VD = NA	None established	Ih, Ig, Con	Respiratory, eyes, dermis, (Ih/Ig may cause cyanosis)	None identified, primarily a localized irritant	No	Content Code 005, solid
Sodium phosphate (7558-79-4) VD = NA	None established	Ih, Ig, Con	Respiratory, eyes, dermis	None identified, primarily a localized irritant	No	Content Code 005, solid

Table 2-4. (continued).

Material or Chemical (CAS #, Vapor Density and Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (acute and chronic)	Target Organs and System	Carcinogen? (source)[e]	Matrix or Source to Be Encountered During Project Operations
Sodium sulfate (7757-82-6) VD = NA	None established	Ih, Ig, Con	Respiratory, eyes, dermis	None identified, primarily a localized irritant	No	Content Code 005, solid
Zirconium (7440-67-7) VD = NA	TLV: 5 mg/m^3 STEL: 10 mg/m^3	Ih, Con	Skin, lung granulomas; irritation skin, mucous membrane; X-ray evidence of retention in lungs	Skin, respiratory system	No	Content Code INEEL waste, solid
Radionuclides (as listed in Table 2-1)						
Radionuclides (radiation fields)	ALARA, dose limit, in accordance with RWP Posting of radiation areas in accordance with INEEL RCM[b] TLDs will be used to measure whole body TEDE.	Whole Body	Alarming electronic dosimetry or stationary radiation monitors or alarms, criticality alarm, and elevated readings on direct reading instruments.	Blood-forming cells, GI tract, and rapidly dividing cells	Yes—IARC	OU 7-10 waste and waste streams, assay system
Radionuclides (fixed and removable surface contamination)	ALARA, dose limit, in accordance with RWP Posting of contamination areas in accordance with PRD-183 (2000)	Ih, Ig, broken skin	Alarming CAMs, high counts on portable air samplers, direct reading instruments, swipe counter (scaler), and alarm indication on PCM.	GI tract, ionization of internal tissue through uptake of radionuclides	Yes—IARC	Contamination from OU 7-10 waste and waste streams

Table 2-4. (continued).

Material or Chemical (CAS #, Vapor Density and Ionization Energy)[a]	Exposure Limit[b] (PEL/TLV)	Routes of Exposure[c]	Indicators or Symptoms of Over-Exposure[d] (acute and chronic)	Target Organs and System	Carcinogen? (source)[e]	Matrix or Source to Be Encountered During Project Operations
Radionuclides (airborne radioactivity)	ALARA, dose limit, in accordance with RWP 10% of DAC for specific radionuclide selected (10 CFR 835, 2002) Posting of airborne radioactivity areas in accordance with PRD-183 (2000)	Ih, Ig, broken skin	Alarming CAMs, high counts on portable air samplers and personal air samplers.	GI tract, ionization of internal tissue through uptake of radionuclides	Yes	OU 7-10 waste and waste streams. Entry into RCS or contaminated areas of PGS.

a. MSDSs for chemicals other than waste types are available at the project.
b. ACGIH (2002); 29 CFR 1910 (2002), 29 CFR 1926 (2002); and substance-specific standards.
c. (Ih) inhalation; (Ig) ingestion; (S) skin absorption; (Con) contact hazard.
d. (Nervous system) dizziness, nausea, lightheadedness; (dermis) rashes, itching, redness; (respiratory) respiratory effects; (eyes) tearing, irritation.
e. If yes, identify agency and appropriate designation (ACGIH A1 or A2, NIOSH, OSHA, IARC, NTP).
f. Clements (1982) reports that pint bottles of mercury were periodically disposed of through the Series 742 sludge waste stream. It is unknown how much, if any, mercury is in OU 7-10 or the OU 7-10 Glovebox Excavator Method Project area. A 1-pt bottle of mercury is assumed to be in the project area.
g. Two 25 lb packs of sodium cyanide or potassium cyanide pellets were distributed in Series 742 sludge waste drums buried in the Subsurface Disposal Area. It is assumed that the cyanide is in the project area.

ACGIH = American Conference of Governmental Industrial Hygienists
ALARA = as low as reasonably achievable
CAM = constant air monitor
CFR = *Code of Federal Regulations*
DAC = derived air concentration
GI = gastrointestinal
IARC = International Agency for Research on Cancer
IH = industrial hygienist
MSDS = material safety data sheet
NIOSH = National Institute of Occupational Safety and Health
NTP = National Toxicology Program
OSHA = Occupational Safety and Health Administration
OU = operable unit
PCM = personal contamination monitor
PEL = permissible exposure limit
PGS = Packaging Glovebox System
RCM = radiological control manual
RCS = Retrieval Confinement Structure
RWP = radiological work permit
TEDE = total effective dose equivalent
TLD = thermoluminescent dosimeter
TLV = threshold-limit value
TWA = time-weighed average

Table 2-5. Summary of project operational activities, associated hazards, and mitigation[a].

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
Excavation Operations (RCS)		
• Overburden removal • Waste retrieval • Underburden sampling • Sample handling and transportation	Radiological: Contamination—OU 7-10 waste material. Radiation exposure—OU 7-10 waste material. Airborne radioactivity—Dust from waste material. Criticality—Accumulation of high FGE material with moderator and proper geometry.	Safety-significant systems and engineering controls (confinement) of the RCS, DSS, controlled access, stationary continuous air and radiation monitors, criticality monitor and alarm, TPRs with hold points, qualified equipment operator, RWP, direct-reading instruments, compliance with MCP-183, "Safeguards and Security (Draft),"[b] radiological posting requirements, PPE, use of TLDs and supplemental dosimetry, and contamination surveys.
	Chemical and nonradiological contaminants—OU 7-10 waste material, airborne contaminants, chemical use for project RCS operations, equipment operation (CO), excavator fuel, preventive maintenance.	Safety-significant systems and engineering controls (confinement) of the RCS, DSS, controlled access, area monitors and direct reading instruments, TPRs with hold points, qualified equipment operator, JSAs, MSDS for all chemicals used, active exhaust system for excavator, and PPE.
	Pinch points, and struck-by or caught-between hazards—Equipment movement and vehicle traffic, forklift movement, soil sack loading and handling, empty drum handling.	Technical procedures, equipment inspections, qualified equipment operators (hoisting and rigging) and forklift operators, backup alarms, JSAs, designated traffic lanes and areas, watch body position, and PPE.
	Lifting and back strain—Staging excavator stands and end effectors and support materials, handling core sampling equipment, manual excavation of overburden,	Mechanical equipment to lift and position heavy items, proper lifting techniques, two-person lifts if items are over 50 lb (or one-third of the person's body weight, whichever is less) or awkward or unbalanced, body position awareness, and use of stands or designed jigs or fixtures for holding heavy items during manipulation tasks.
	Heat and cold stress—Working outdoors and tasks requiring use of protective clothing and respiratory protection.	Industrial hygienist monitoring, PPE, training, work and rest cycles as required (MCP-2704 2002), stay times documented on SWP (or equivalent).

Table 2-5. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
	Tripping hazards and working and walking surfaces—Uneven surfaces and terrain, ice-, snow-, mud-covered or wet surfaces, probes in pit, lines and cords, and ladders.	Good housekeeping, awareness of walking surfaces, salt and sand icy areas (where required), and use of nonskid or high-fiction materials on walking surfaces, lines and cords maintained out of established aisles and walkways, proper footwear, and three-point contact when ascending and descending ladder.
	Stored energy sources—Elevated materials, electrical, compressed gases, hoisting and rigging (soil sacks), fire (refueling), running vehicles.	Secure all materials stored at elevated locations, identify and mark all utilities, ensure all lines and cords are checked for damage and continuity, use GFCI (circuit or receptacle) for all outdoor equipment and for all temporary installations, comply with minimum clearances for overhead lines, and secure compressed cylinders, caps, and bottles before movement, conduct inspections of equipment, grounding and bonding during all refueling operations, set brake and use tire chalks where appropriate, and do not leave any running vehicles or equipment unattended.
	Hazardous noise—Areas around equipment and when operating equipment.	Source identification and labeling, Industrial Hygiene sound level monitoring and dosimetry, isolation, and PPE (as required).
Glovebox Operations (PGS)		
• Waste packaging • Waste Sorting • Waste handling • Drum preparation • Drum load out	Radiological: Contamination—OU 7-10 waste material. Radiation exposure—OU 7-10 waste material. Criticality—Overloaded drum.	Safety significant systems and engineering controls (confinement) of the PGS, controlled access, air and radiation monitors, fissile material monitor, TPRs with hold points, qualified glovebox operators, RWP, direct-reading instruments, compliance with MCP-183[b] radiological posting requirements, PPE, use of TLDs and supplemental dosimetry, and contamination surveys.

Table 2-5. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
	Chemical and nonradiological contaminants—OU 7-10 waste material handling, chemical use for project PGS operations, airborne contaminants, equipment operation, refueling, and preventive maintenance.	Safety significant systems and engineering controls (confinement) of the PGS, controlled access, area monitors and direct reading instruments, TPRs with hold points, qualified glovebox operators, JSAs, MSDSs for all chemicals used, and PPE.
	Pinch points, struck-by, or caught-between hazards—Equipment, hoist and drum movement and forklift operations.	Technical procedures, equipment inspections, designated operators (hoist), qualified forklift operators, backup alarms, JSAs, designated traffic lanes and areas, watch body position, and PPE.
	Lifting and back strain—Lifting glovebox loadout cover, handling and positioning waste in glovebox, drum loadout, drum preparation, waste sorting, and sample movement.	Mechanical lifting devices (e.g., hoist) used to lift and move heavy waste items and loadout cover, proper lifting techniques, two-person lifts if items are over 50 lb (or one-third of the person's body weight, whichever is less) or awkward or unbalanced, and awareness of body position. Ergonomic assessments performed by IH as deemed appropriate.
	Heat and cold stress—Support work outdoors	Industrial Hygiene monitoring, PPE, training, and work-rest cycles (as required).
	Tripping hazards and working and walking surfaces—Uneven surfaces and terrain, ice-, snow-, mud-covered or wet surfaces, material storage on elevated work platforms, lines and cords, and ladders.	Good housekeeping, awareness of walking surfaces, salt and sand icy areas (where required), and use of nonskid or high-fiction materials on walking surfaces, proper footwear, lines and cords maintained out of established aisles and walkways, and three-point contact when ascending and descending ladder.
	Stored energy sources—Elevated materials (drums and hoisted materials and waste), electrical, running industrial vehicles (e.g., forklift).	Secure all materials stored at elevated locations, inspect all lines and cords before use, use GFCI (circuit or receptacle) for all outdoor equipment and where liquids may be present, conduct inspections of tools, set brake and use tire chalks where appropriate, and do not leave any running vehicles or equipment unattended.

Table 2-5. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
	Cutting, crushing, and pinch points—Glovebox tools and equipment, sizing operations, debris handling, sampling.	Follow manufacturer's operating instructions, keep areas clear of nonessential materials, wear required PPE (as listed in the JSA), be aware of body position and other glovebox personnel before starting and during tool use.
	Hazardous noise—Sizing tools and during operation of the forklift.	Source identification and labeling, IH sound level monitoring or dosimetry, isolation, and PPE (as required).
General Project Operational Support Tasks		
• Drum handling • Forklift operations • Waste transportation and storage • Waste inspections • Drum assay	Radiological: Contamination—OU 7-10 waste material. Radiation exposure—OU 7-10 waste material. Assay system operation—drum assay for storage.	Engineering controls, controlled access, TPRs, qualified positions (where required), RWP, direct-reading instruments, collection and counting of swipes, compliance with MCP-183[b] radiological posting requirements, interlocks (assay system), PPE, use of TLDs and supplemental dosimetry, and contamination surveys.
	Chemical and nonradiological contaminants—OU 7-10 waste container handling, chemical use for project operations, equipment operation, refueling, preventive maintenance, cryogenics (LN_2) for assay detector cooling.	Engineering controls, controlled access, area monitors and direct reading instruments, TPRs, JSAs, MSDS for all chemicals used, follow MCP-2736 (1997) requirements for cryogenic use and handling, and PPE.
	Pinch points, struck-by or caught-between hazards—Equipment, drum movement, forklift operations, material handling tasks.	Technical procedures, equipment inspections, qualified forklift operators, JSAs, backup alarms, designated traffic lanes and areas, proper body position, and PPE.
	Lifting and back strain—Material handling, handling and positioning waste containers and sample movement.	Mechanical lifting devices (e.g., forklift) to lift and move heavy waste items, proper lifting techniques, two-person lifts if items are over 50 lb (or one-third of the person's body weight, whichever is less) or awkward or unbalanced, and awareness of body position. An IH may perform ergonomic assessments as deemed appropriate.
	Heat and cold stress—Support work outdoors	Monitoring by IH, PPE, training, and work-rest cycles (as required).

Table 2-5. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
	Tripping hazards and working and walking surfaces—Uneven surfaces and terrain, ice-, snow-, mud-covered or wet surfaces, lines and cords, entry into waste storage area, and ladders.	Good housekeeping, awareness of walking surfaces, salt and sand icy areas (where required), and use nonskid or high-fiction materials on walking surfaces, proper footwear, keep lines and cords out of established aisles and walkways, and three-point contact when ascending and descending ladder.
	Stored energy sources—Elevated materials (stored drums and waste), compressed gas (P_{10}), running industrial vehicles (forklift).	Secure all materials stored at elevated locations, inspect all lines and cords before use, use GFCI (circuit or receptacle) for all outdoor equipment and where liquids may be present, secure compressed cylinders, caps, and bottles before movement, conduct inspections of tools, set brake and use tire chalks where appropriate, and do not leave any running vehicles or equipment unattended.
	Hazardous noise—Areas around equipment and when operating some equipment or while using hand tools.	Source identification and labeling, IH sound level monitoring or dosimetry, isolation, and PPE (as required).
Decontamination Tasks		
• Operational tools and equipment • RCS and PGS preliminary decontamination	Radiological: Contamination—OU 7-10 waste material. Radiation exposure—Hot particles or dose rate associated with decontamination waste and debris.	Radiological work permit, RCT surveys, hold points, direct-reading instruments, collection and counting of swipes, compliance with MCP-183[b] radiological posting requirements, PPE, and use of dosimetry or survey requirements, and ALARA principles (Section 4).
	Chemical and nonradiological contaminants—Contaminants associated with decontamination process and secondary waste streams generated.	Controlled areas, JSAs, SWPs (as required), air monitoring and sampling, direct reading instruments, TPRs, and PPE.
	Pinch points, struck-by, and caught-between—Positioning items to be decontaminated.	Job safety analyses, TPRs, watch body position, and PPE.

Table 2-5. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
	Lifting and back strain—Moving and positioning components and decontamination waste containers.	Use mechanical lifting devices where possible, proper lifting techniques and two-person lifts if items are over 50 lb (or one-third of the person's body weight, whichever is less) or in awkward or unbalanced situations, and an IH will conduct ergonomic evaluation of tasks (as required).
	Heat and cold stress—Working outdoors and in PPE	Monitoring by IH, PPE, training, work and rest cycles as required (MCP-2704 2002), stay times documented on SWP (or equivalent).
	Tripping hazards and working and walking surfaces—Uneven surfaces and terrain, ice- and snow-covered and wet surfaces.	Awareness of walking surfaces, salt and sand icy areas, and use nonskid or high-fiction materials on walking surfaces, wear adequate footwear with traction sole.
	Electrical—Use of electrical equipment or equipment in area where water of wet surfaces are present.	Use of GFCI outlets or extension cords outdoors and where water or wet surfaces are present. Use of barrier material to isolate overspray.
Maintenance of Project Systems		
• Electrical • Piping, valves, fittings, hoses • Communication • Heating, and ventilating • Mechanical equipment	Radiological contamination—Contact with waste material, contaminated equipment, and components. Radiation exposure—In close proximity to waste containers and contamination with associated dose rate.	Engineering controls (confinement), RWP, RCT surveys, work package hold points, direct-reading instruments, collection and counting of swipes, compliance with MCP-183[b] radiological posting requirements, PPE, and use of dosimetry and survey requirements, and ALARA principles (Section 4).
	Chemical and inorganic contaminants—Contact with waste material, contaminated equipment, and components, hydraulic fluids, fuel, and use of chemicals associated with maintenance tasks.	Controlled areas, JSAs, SWPs (as required), work package hold points, air monitoring and sampling, direct reading instruments, MSDS for all chemicals, and PPE.
	Pinch points, struck-by or caught-between hazards—Equipment, drum movement, forklift operations, material handling tasks.	Technical procedures, equipment inspections, qualified forklift operators, JSAs, designated traffic lanes and areas, backup alarms, watch body position, and PPE.

Table 2-5. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
	Lifting and back strain—Moving and positioning components.	Use mechanical lifting and positioning devices, proper lifting techniques and two-person lifts if items are over 50 lb (or one-third of the person's body weight, whichever is less) or awkward and unbalanced, IH conduct ergonomic evaluation of tasks (as required).
	Heat and cold stress—Working outdoors and in PPE	Industrial hygienist monitoring, PPE, training, work-rest cycles as required (MCP-2704 2002), stay times documented on SWP (or equivalent).
	Tripping hazards and working-walking surfaces—Uneven surfaces and terrain, ice- and snow-covered and wet surfaces, and ladders.	Awareness of walking surfaces, salt and sand icy areas, and use nonskid or high-fiction materials on walking surfaces, wear adequate footwear with traction sole, and three-point contact when ascending and descending ladder.
	Hoisting and rigging—Equipment and component movement and placement, project overhead hoists.	Qualified operators, equipment and rigging inspections, hoisting and rigging operations in accordance with PRD-160 (2000) and applicable facility supplement.
	Stored energy—Electrical, mechanical, thermal, elevated materials, pressurized systems, cylinders, and fire systems.	Piping and conduit labeling, LO/TO training, STD-101 (2001) work packages, LO/TO in accordance with MCP-3650 (2001), MCP-3651 (2001), and PRD-5051 (2001).
	Elevated work or work near open excavation.	Fall protection training, use of fall protection system and devices, fall protection competent person, and follow all requirements of PRD-5096 (2001).
Facility Lay-up		
• Backfill excavation • Fix removable contamination • Final decontamination on RCS and PGS	Radiological: Contamination—OU 7-10 waste material. Radiation exposure—Hot particles or dose rate associated with decontamination waste and debris.	Engineering controls (ventilation), controlled areas, TPRs, RWP, RCT surveys, fixed and portable air sampling instruments, hold points, direct-reading instruments, collection and counting of swipes, compliance with MCP-183[b] radiological posting requirements, PPE, and use of dosimetry and survey requirements, and ALARA principles (Section 4).

Table 2-5. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
• Secure WMF-671 WES	Chemical and nonradiological contaminants—Contaminants associated with decontamination process and secondary waste streams generated, decontamination solutions, spray fixative compound(s), grout, fuel, hydraulic fluids, compressed gas cylinders.	Controlled areas, TPRs, JSAs, SWPs (as required), MSDS for chemicals used for decontamination, fixative, grout and fluids drained, air monitoring and sampling, direct reading instruments, PPE.
	Pinch points, struck-by, or caught-between—Vehicle and equipment movement, material and equipment handling, use of hand and power tools.	Vehicles use designated traffic lanes and ramps, backup alarms, JSAs, TPRs, watch body position, and wear PPE.
	Lifting and back strain—Moving and positioning grout hose, lifting components, positioning equipment, carrying decontamination and fixadent equipment and supplies or components.	Use mechanical lifting devices where possible, proper lifting techniques and two-person lifts if items are over 50 lb (or one-third of the person's body weight, whichever is less) or awkward and unbalanced, IH conduct ergonomic evaluation of tasks (as required).
	Heat and cold stress—Working outdoors and in PPE	Industrial hygienist monitoring, PPE, training, work-rest cycles as required (MCP-2704 2002), stay times documented on SWP (or equivalent).
	Tripping hazards and working-walking surfaces—Uneven surfaces and terrain, ice- and snow-covered and wet surfaces, plastic sheeting, cords, hoses, and lines, and ladders.	Awareness of walking surfaces, salt and sand icy areas, and use nonskid or high-fiction materials on walking surfaces, keep lines and cords out of established aisles and walkways, wear adequate footwear with traction sole.
	Electrical—Use of electrical equipment or equipment in area where water of wet surfaces are present.	Use of GFCI outlets or extension cords outdoors and where water or wet surfaces are present. Use of barrier material to isolate overspray.

Table 2-5. (continued).

Activity or Task	Associated Hazards or Hazardous Agent	Hazard Mitigation
a. All hazards will be identified, evaluated and controls established in accordance with PRD-25 (1999), "Activity Level Hazard Identification, Analysis, and Control," requirements. Additionally, project assigned industrial hygienist, safety professional, and RadCon personnel will be available to assist with the PRD-25 (1999) process and to assist in the develop of TPRs, work orders or packages, and permits associated with project operational activities. b. MCP-183, "Safeguards and Security (Draft)." ALARA = as low as reasonably achievable DSS = dust-suppression system GFCI = ground-fault circuit interrupter JSA = job safety analyses LO/TO = lockout and tagout MCP = management control procedure MSDS = material safety data sheet PPE = personal protective equipment PRD = program requirements document RadCon = Radiological Control RCT = radiological control technician RWP = radiological work permit STD = standard SWP = safe work permit TLD = thermoluminescent dosimeter TPR = technical procedure WES = Weather Enclosure Structure		

Radiological work permits (RWPs) will be used and safe work permits (SWPs) may be used in conjunction with this HASP to provide task- or activity-specific requirements for project operations. When used, these permits will further detail specialized PPE and dosimetry requirements.

2.2 Safety and Physical Hazards and Mitigation

Industrial safety and physical hazards will be encountered while performing project operations. Section 4.2 provides general safe-work practices that must be followed at all times. This section describes specific industrial safety hazards and procedures to be followed to eliminate or minimize safety and physical hazards that will be encountered by project personnel.

2.2.1 Material Handling and Back Strain

Material handling and maneuvering of various pieces of equipment, drums, end effector stands, and waste in the PGS during project operations may result in employee injury. Mechanical lifting devices such as hoists and forklifts will be used wherever possible to eliminate the need for manual materials handling and lifting. Where these devices are not feasible, lifting and material-handling tasks will be performed in accordance with MCP-2692 (2002), "Ergonomic Program." Personnel will not physically lift objects weighing more than 50 lb or 33% of their body weight (whichever is less) alone.

The IH will conduct ergonomic evaluations of various project operations to determine the potential ergonomic hazards presented by various material handling and equipment use operations. Following this evaluation, the IH will provide recommendations to mitigate these hazards including additional engineering controls or work practices. Applicable requirements from MCP-2739 (1997), "Material Handling, Storage, and Disposal," will also be followed.

2.2.2 Repetitive Motion and Musculoskeletal Disorders

Project operational tasks such as material handling and glovebox operations may expose personnel to repetitive-motion hazards, undue physical stress, overexertion, awkward postures, or other ergonomic risk factors that may lead to musculoskeletal disorders. Musculoskeletal disorders can cause a number of conditions including pain, numbness, tingling, stiff joints, difficulty moving, muscle loss, and sometimes paralysis. The assigned project industrial hygienist will evaluate project tasks and provide recommendations to reduce the potential for musculoskeletal disorders in accordance with MCP-2692 (2002).

2.2.3 Working and Walking Surfaces

Slippery work surfaces can increase the likelihood of back injuries, overexertion injuries, slips, and falls. project operations inside the WMF-671 WES will present potential tripping or slip hazards from uneven flooring surfaces, equipment cords, pit surface during manual excavation (probes), wet surfaces or floor obstructions. Outside the WMF-671 WES the potential for slip, trip, and fall hazards will increase during winter months because of ice- and snow-covered surfaces. All personnel will be made aware of tripping hazards that cannot be eliminated by marking them (e.g., probes). All operations personnel will wear required protective footwear with adequate traction sole to further mitigate slip and fall potential. Tripping and slip hazards will be evaluated during the course of the project in accordance with PRD-5103 (2001), "Walking and Working Surfaces."

2.2.4 Proper Housekeeping to Prevent Slips, Trips, and Falls

The floor of every WMF-671 WES, RCS, and PGS area shall be maintained, so far as possible, in a clean and dry condition. All walking and working surfaces will be kept clean, orderly, and free of foreign objects to prevent possible slip, trip, and fall hazards. Proper drainage and use of dry standing stations will be provided where wet processes (e.g., decontamination) are used that could cause a potential slip and fall hazard. All tools and equipment used during each shift will be placed back in the designated storage location unless required to be left in place. Cords and lines will be routed around walkways, stairs, and entrances and exits to eliminate tripping hazards. Elevated walkways and platforms will be kept clear of potential tripping hazards at all times.

2.2.5 Elevated Work Areas

Personnel performing maintenance tasks or other operations may be required to work on elevated equipment or at heights above 6 ft. Personnel required to access the RCS area around the pit excavation (with an unprotected side or edge [trench box] which is 6 ft or more above a lower level) shall be protected from falling by the use of guardrail systems, personal fall-arrest systems or fall restraint system (travel restriction system) that prevents personnel from approaching the fall hazard in accordance with PRD-5096 (2001), "Fall Protection."

Although not anticipated, leading edge work in areas that will not allow for traditional fall protection controls will require a fall protection plan to be prepared in accordance with PRD-5096 (2001). Additionally, the following MCP requirements will be followed as they relate to project operations associated with elevated work:

- MCP-2709 (2001), "Aerial Lifts and Elevating Work Platforms"
- PRD-5067 (2001), "Ladders"
- PRD-5098 (2001), "Scaffolding."

2.2.6 Means of Egress

Established means of egress (continuous and unobstructed way of travel to an exit, exit access, and exit discharge) shall be maintained within all WMF-671 WES and RCS areas in accordance with NFPA 101 (2000), "Life Safety Code," requirements. This includes emergency lighting, illumination of signs, and marking of means of egress. A functional test of emergency lighting shall be conducted on every required emergency lighting system at 30-day intervals for not less than 30 seconds. An annual test shall be conducted on every required battery-powered emergency lighting system for not less than 1-1/2 hours (unless the system meets the exception under the Section 7.9.3 of the "Life Safety Code"). Equipment shall be fully operational for the duration of the test. Written records of the visual inspections and tests shall be maintained.

2.2.7 Powered Equipment and Tools

Powered equipment and tools will be used during project operations for material handling and glovebox operations. Use of this equipment presents potential physical hazards (e.g., pinch points, electrical hazards, flying debris, struck-by, and caught-between) to personnel operating them. All portable equipment and tools will be properly maintained and used by qualified individuals and in accordance with the manufacturer's specifications. At no time will safety guards be removed. Requirements from PRD-5101 (2001), "Portable Equipment and Handheld Power Tools," will be followed for all work

performed with powered equipment including hand tools. All tools will be inspected by the user before use.

2.2.8 Electrical Hazards and Energized Systems

Electrical equipment and tools, as well as maintenance of project facility electrical systems, may pose shock or electrocution hazards to personnel. Ground-fault protected electrical circuits and receptacles in combination with safety-related work practices will be employed to prevent electric shock or other injuries resulting from direct or indirect electrical contact. All electrical work will be reviewed and completed under the appropriate work controls (e.g., technical procedures [TPRs] or work orders). Before conducting electrical work, hazardous energy of the affected system will brought to a zero energy state through the use of isolation methods in accordance with the following:

- MCP-3650 (2001), "Chapter IX Level I Lockouts and Tagouts"
- MCP-3651 (2001), "Chapter IX Level II Lockouts and Tagouts"
- Applicable facility supplemental procedures for the system or component being worked.

If work on energized systems is necessary, these practices will conform to the requirements in PRD-5099 (2001), "Electrical Safety," and Parts I through III of the NFPA 70E (2000), "Electrical Safety Requirements for Employee Work Places." Additionally, all electrical and other utilities will be identified before conducting surface penetration maintenance activities in accordance with PRD-22 (1999), "Excavation and Surface Penetrations."

2.2.9 Operational Fire Hazards and Prevention

The *Fire Hazards Analysis for the OU 7-10 Glovebox Excavator Method Project* (Gosswiller 2002) and the hazards analysis identify the fire hazards as fire involving the following:

- Contents of the excavation pit
- Retrieval equipment
- Materials in the PGS
- Combustible materials in the WMF-671 WES exterior to the RCS and PGS, and fire involving packaged waste materials during transport.

From the inventory discussion in Section 2, approximately 21% of the waste material in the excavation area is considered combustible. Nitration reaction and mixtures with free-flammable or combustible liquids may have increased the flammability of the combustible materials. Combustible liquids (mainly oils in both damaged and intact containers) are expected. Pyrophoric metals in the form of plutonium oxide or hydrated plutonium oxide are present in small quantities in the retrieval area. These could be fire initiators. There is no indication that other pyrophoric metals such as zirconium turnings are in the excavation area. Hydrogen generation, because of the radiolysis of waste zone materials, is expected in staged and stored containers of waste; however, because of the deteriorated condition of waste containers in the retrieval area and venting of drums, the risk of an explosion from retrieved containers is very low (Gosswiller 2002).

Firewater distribution for the project is provided through a connection to the existing RWMC firewater distribution system. The project dry-pipe, deluge, and fire department hose systems interface with the RWMC firewater distribution system at the Fire Riser Building. Because of excavation restrictions at the SDA, the firewater delivery system from the Fire Riser Building to the suppression systems is aboveground and is maintained dry to ensure the system will not freeze during cold weather.

Project objectives identified by DOE Order 420.1A, "Facility Safety," are met by the Project Fire Hazards Analysis (Gosswiller 2002). Review and approval of an equivalency request by DOE-ID also found that the fire protection strategy adequately satisfies the fire protection objectives of DOE Order 420.1A, and that it has been demonstrated that an equivalent level of fire protection to that specified in NFPA 801 (1998), "Standard for Fire Protection for Facilities Handling Radioactive Material," has been provided (see Footnote B).

2.2.10 Flammable and Combustible Materials Hazards

Fuel will be required for the excavator and other equipment during project operations. Flammable hazards include transfer and storage of flammable or combustible liquids in the project operations area. Portable fire extinguishers with a minimum rating of 10A/60BC shall be strategically located at the facility to combat Class ABC fires. Portable fire extinguishers will be located in all active project operations areas, on or near all facility equipment that has exhaust heat sources, and on or near all equipment capable of generating ignition or having the potential to spark. When storing project chemicals, MCP-2707 (2001), "Compatible Chemical Storage," will be consulted. The requirements of MCP-584 (1997), "Flammable and Combustible Liquid Storage and Handling," will be followed at all times.

2.2.10.1 Combustible Materials. Combustible or ignitable materials in contact with or near exhaust manifolds, catalytic converters, or other ignition sources could result in a fire. The assigned fire protection engineer should be contacted if questions arise about potential ignition sources. The accumulation of combustible materials will be strictly controlled in all project operational areas including the surrounding project and support trailers area. Class A combustibles (e.g., trash, cardboard, rags, wood, and plastic) will be properly disposed of in appropriate waste containers. The fire protection engineer also may conduct periodic site inspections to ensure all fire protection requirements are being met.

2.2.10.2 Flammable and Combustible Liquids. Fuel used at the project for fueling the excavator and generator(s) must be safely stored, handled, and used. Only portable containers approved by Factory Mutual and Underwriters Laboratories (labeled with the contents) will be used to store flammable liquids. All fuel containers will be stored at least 50 ft from any facilities and ignition sources, stored inside an approved flammable storage cabinet or tank meeting the requirement s of NFPA 30 (1998), "Flammable and Combustible Liquids Code." Portable motorized equipment (e.g., generators and light plants) will be shut off and allowed to cool down in accordance with the manufacturer's operating instructions before being refueled to minimize the potential for a fuel fire.

2.2.10.3 Welding, Cutting, or Grinding. Personnel conducting welding, cutting, or grinding tasks may be exposed to molten metal, slag, and flying debris. Additionally, a fire potential exists if combustible materials are not cleared from the work area. Requirements from PRD-5110 (2001), "Welding, Cutting, and Other Hot Work," will be followed whenever these types of activities are conducted. This includes the requirement for a hot work permit (documented on a safe work permit) and designation of a fire watch.

2.2.11 Pressurized Systems

Pressurized plant and breathing air systems will be operated in support of project operations. The hazards presented to personnel, equipment, facilities or the environment because of inadequately designed or improperly operated pressure systems (vessels) include blast effects, shrapnel, fluid jets, equipment damage, personnel injury, and death. These systems can include pneumatic, hydraulic, or compressed-gas systems. The applicable requirements in PRD-5 (2002), "Boilers and Unfired Pressure Vessels," must be followed as well as the manufacturer's operating and maintenance instructions. This includes inspection, maintenance, and testing of systems and components in accordance with applicable American National Standards Institute (ANSI) requirements.

All pressure systems will be operated within the designed operating pressure range, which is typically 10 to 20% less than the maximum allowable working pressure. Additionally, all hoses, fittings, lines, gauges, and system components will be rated for the system for at least the maximum allowable working pressure (generally the relief set point). The project safety professional should be consulted about any questions of pressure systems in use at the project site.

2.2.12 Cryogenics

Cryogenics may be used in support of project operations for cooling of detectors or other applications. If required, all cryogenic tasks will be conducted and protective equipment worn in accordance with MCP-2736 (1997). Personal protective equipment will be worn at all times when handling, transferring, or dispensing cryogenic liquids in accordance with MCP-2736 (1997). Additional hazards associated with cryogenic liquids include the following:

- **Pressure buildup:** Boiling of liquefied gases within a closed system increases pressure. Cryogenic liquids will not be contained in a closed system other than an approved Dewar. Cold fingers and similar devices have exploded when either an ice dam has formed within the apparatus or when users created a closed system by shutting off all of the valves.

- **Oxygen enrichment:** Liquid nitrogen may fractionally distill air, causing liquid oxygen to collect in the cryogenic container. Liquid oxygen increases the combustibility of many materials, creating potentially explosive conditions. Adequate venting will be provided when working with cryogenic liquids in a closed system or enclosed space.

- **Asphyxiation:** If vented into a closed space, a cryogenic liquid will vaporize, displacing oxygen and possibly causing asphyxia. Cryogenic liquid will not be stored in a closed space.

- **Embrittlement:** Cryogenic liquids will not be disposed down any drains. Ordinary materials such as metal or PVC piping may not be able to withstand cryogenic temperatures. Cryogenic liquids will be allowed to evaporate in a well-ventilated area. Materials exposed to cryogenic temperatures for long periods or materials that have undergone periodic warming and freezing will be examined regularly for cracks and warping.

2.2.13 Compressed Gases

Compressed gases may be used in support of project operations. If used, all cylinders will be used, stored, handled, and labeled in accordance with PRD-5040 (2002), "Handling and Use of Compressed Gases." All transportation, handling, storage, and use of compressed-gas cylinders will be conducted in accordance with the Compressed Gas Association Pamphlet P-1-1965, "Safe Handling of Compressed

Gases" (CGA 1965). Additionally, the assigned project safety professional should be consulted about any compressed gas cylinder storage, transport, and use issues.

2.2.14 Excavator, Equipment, and Vehicle Hazards

The excavator and forklifts will be used as part of the project operations. Hazards associated with the operation of the excavator and forklifts include injury to personnel (e.g., struck by and caught between hazards), equipment contact with the RCS, and property damage. All equipment will be operated in the manner in which it was intended and in accordance with the manufacturer's instructions or equipment design. Only authorized qualified personnel will be allowed to operate equipment. Personnel in proximity to operating equipment must maintain visual communication with the operator and stay out of the arm swing radius. Personnel also must comply with the applicable requirements of the following:

- MCP-2745 (2001), "Heavy Industrial Vehicles"
- PRD-5123 (2002), "Motor Vehicle Safety"
- DOE-STD-1090-01 (2001), Chapter 10, "Forklift Trucks."

Additional safe practices will include the following:

- All parked forklifts will have the forklift tines in the lowered position (resting on ground or floor).
- All heavy equipment and industrial vehicles will have backup alarms.
- Walking directly behind or to the side of equipment without the operator's knowledge is prohibited.
- While operating equipment in the work area, the equipment operator will maintain communication with a designated person who will be responsible for providing direct voice contact or approved standard hand signals. In addition, all facility personnel in the immediate work area will be made aware of the equipment operations.
- All equipment will be operated away from established traffic lanes and personnel access ways (whenever possible) and will be stored so as not to endanger personnel at any time.
- All unattended equipment will have appropriate reflectors or be barricaded if left on or next to roadways.
- All parked equipment will have the parking brake set and chocks will be used when equipment is parked on inclines.
- Personnel will be protected from the excavator swing radius when working inside the RCS. This may be accomplished by any or a combination of the following as determined appropriate by the safety professional and documented in work control. The swing radius area may be barricaded or marked to warn personnel, train personnel on the swing radius and the safe work practices required for the task and work location, or shutting down the excavator when personnel are working inside the swing radius area.

2.2.15 Excavation, Surface Penetrations, and Outages

No utilities or lines are buried in the project area to be excavated. Existing Type A and B probes will be hand excavated to prevent damage until they can be dislodged and set aside during waste retrieval operations.

Excavation of the targeted project area will progress in the sequence specified in the "Excavation Plan and Sequential Process Narrative for the OU 7-10 Glovebox Excavator Method Project (Draft)."[g] The basic sequence will involve the following:

- Hand excavation around areas that will be hard to reach with the excavator (e.g., cluster of probes). A rough estimate of the manually excavated material is 120 ft^3 or about two soil sacks.

- The backhoe will remove overburden soils in two passes (depth of 2 ft followed by removal of the remaining overburden on the next pass) across the entire dig area, and removed overburden soil will be placed in soil sacks.

Waste excavation will proceed in stages with three discrete sections being excavated in sequence:

- Section 1 will excavate approximately one-half of the total pit volume and will core sample the underburden within this section

- Section 2 will remove the remaining balance of the waste zone material to be removed and will core sample the underburden within this section

- Section 3 will expose the underburden in proximity of the P9-20 probe for sampling.

All of the required underburden core sampling will be performed within these sections. A 52% angle of repose for the excavation will try to be maintained if the excavator is not capable of cutting vertical faces through the waste.

Modifications to the project structures in support of operations that will require surface penetrations. No surface penetrations will be allowed or conducted until the area has been evaluated and an approved subsurface evaluation documented. All surface penetrations and related outages will be coordinated through the field supervisor and will require submittal of a Form 433.01 (1999), "Outage Request." The submission of an outage request will not be considered an approval to start the work.

All excavation and surface penetration activities will be conducted and monitored in accordance with PRD-22 (1999), "Excavation and Surface Penetrations," and 29 CFR 1926, Subpart P, "Excavations," (29 CFR 1910, 2002). Key elements from these requirements include the following:

- Daily inspections of excavations and protective systems (shoring box) will be made by a competent person (visual inspection from outside the RCS) for evidence of situations that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection will be conducted by the excavation competent person before the start of work and as needed throughout the shift. Inspections also will be made following any

[g] Jamison, R. Kirt, and Brian D. Preussner, 2002, "Excavation Plan and Sequential Process Narrative for the OU 7-10 Glovebox Excavator Method Project (Draft)," INEEL/EXT-02-00703, Rev. B, Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho, August 2002.

hazard-increasing occurrence. These inspections are required only when employee exposure can be reasonably anticipated.

- Designs of support systems, shield systems, and other protective systems shall be selected and constructed in accordance with the requirements set forth in 29 CFR 1926, Subpart P (29 CFR 1910, 2002). The project shoring system and excavation method has been designed and approved by a professional engineer.

- When material or equipment used for protective systems is damaged, a competent person shall examine the material or equipment and evaluate its suitability for continued use. If the competent person cannot assure the material or equipment is able to support the intended loads or is otherwise suitable for safe use, then such material or equipment shall be removed from service, and shall be evaluated and approved by a registered professional engineer before being returned to service.

2.2.16 Hoisting and Rigging of Equipment

A hoist system in the PGS will be use in support of project operation and maintenance tasks. All hoisting and rigging operations will be performed in accordance with PRD-160 (2000), "Hoisting and Rigging," and DOE-STD-1090-01 (2001) as applicable for these project operations.

Hoisting and rigging equipment will show evidence of a current inspection (e.g., tag) and be inspected before use by designated operators. Additionally, if mobile crane or boom trucks are used in support of project operations, the operator or designated person for mobile cranes or boom trucks will perform a visual inspection each day or before use (if the crane has not been in regular service) of items such as, but not limited to, the following:

- All control mechanisms for maladjustment that would interfere with proper operation

- Crane hooks and latches for deformation, cracks, and wear

- Hydraulic systems for proper oil level

- Lines, tanks, valves, pumps, and other parts of air or hydraulic systems for leakage

- Hoist ropes for kinking, crushing, birdcaging, and corrosion

- All anti-two-block, two-block warning, and two-block damage prevention systems for proper operation.

Note: The operator or other designated person will examine deficiencies and determine whether they constitute a safety hazard. If deficiencies are found, they will be reported to the safety professional.

2.2.17 Overhead Hazards

Personnel may be exposed to overhead impact (contact) hazards during the course of the project operations from walking in, between, and around operational equipment and support structures in the WMF-671 WES, RCS, PGS, and storage buildings.. Sources for these hazards will be identified and mitigated in accordance with PRD-5103 (2001), "Walking and Working Surfaces." In the case of overhead impact hazards, they will be marked by using engineering-controls protective systems where there is a potential for falling debris, in combination with head protection PPE.

2.2.18 Personal Protective Equipment

Wearing PPE will reduce a worker's ability to move freely, see clearly, and hear directions and noise that might indicate a hazard. In addition, PPE can increase the risk of heat stress. Work activities at the task site will be modified as necessary to ensure that personnel are able to work safely in the required PPE. Work-site personnel will comply with PRD-5121 (2002), "Personal Protective Equipment," and MCP-432 (2000), "Radiological Personal Protective Equipment." All personnel who wear PPE will be trained in its use and limitations in accordance with PRD-5121 (2002) and 29 CFR 1910, Subpart I, "Personal Protective Equipment," (29 CFR 1910, 2002).

2.2.19 Decontamination

Decontamination of waste containers, powered equipment, tools, and WMF-671 WES, RCS, and PGS components will be required as part of project operations. Decontamination procedures for personnel and equipment are detailed in Section 11. Potential hazards to personnel conducting decontamination tasks include back strain; slip, trip, and fall hazards; and cross-contamination from contaminated surfaces. Additionally, electrical hazards may be present if water is used in areas with exposed electrical cords or receptacles. Mitigation of these walking working surfaces and electrical hazards are addressed in prior subsections. If a power washer or heated power washer is used, units will be operated in accordance with manufacturer's operating instructions, personnel will wear appropriate PPE to prevent high-pressure spray injuries, use GFCI protection, and these tasks will only be conducted in approved areas. Personnel will wear required PPE at all times during decontamination tasks as listed in Section 5 and as listed on the associated JSA and RWP.

2.3 Environmental Hazards and Mitigation

Potential environmental hazards will present potential hazards to personnel during project operations. These hazards will be identified and mitigated to the extent possible. This section describes these environmental hazards and states what procedures and work practices will be followed to mitigate them.

2.3.1 Noise

Personnel performing project operations activities may be exposed to noise levels from the excavator trucks, hand tools, and compressors that exceed 85 decibel A-weighted (dBA). For an 8-hour time-weighted average (TWA), 83 dBA for 10-hour TWA. The effects of high sound levels (noise) may include the following:

- Personnel being startled, distracted, or fatigued
- Physical damage to the ear and pain and temporary or permanent hearing loss
- Interference with communication that would warn of danger.

Where noise levels are suspected of exceeding 80 dBA, noise measurements will be performed in accordance with MCP-2719 (2002), "Controlling and Monitoring Exposure to Noise," to determine if personnel are routinely exposed to noise levels in excess of the applicable TWA (85 dBA for 8 hours of exposure or lower TWA for 10- or 12-hour work-shift exposures).

Note: Exposures exceeding 8-hours per day will be evaluated by the assigned project IH.

Personnel whose noise exposure routinely meets or exceeds the allowable TWA will be enrolled in the INEEL Occupational Medical Program (OMP) (or subcontractor hearing conservation program as applicable). Personnel working on jobs that have noise exposures greater than 85 dBA will be required to wear hearing protection until noise levels have been evaluated and will continue to wear the hearing protection specified by the IH until directed otherwise. Hearing protection devices will be selected and worn in accordance with MCP-2719 (2002).

2.3.2 Heat and Cold Stress and Ultraviolet Light Hazards

Project operational tasks will be conducted during times when there is a potential for both heat and cold stress that could present a potential hazard to personnel. The assigned IH will be responsible for obtaining meteorological information to determine if additional heat or cold stress administrative controls are required. All operations personnel must understand the hazards associated with heat and cold stress and take preventive measures to minimize the effects. Management Control Procedure-2704 (2002), "Heat and Cold Stress," guidelines will be followed when determining work and rest schedules or when to halt work activities because of temperature extremes.

2.3.2.1 Heat Stress. High ambient air temperatures can result in increased body temperature, heat fatigue, heat exhaustion, or heat stroke that can lead to symptoms ranging from physical discomfort, to unconsciousness, to death. In addition, operational tasks requiring the use of PPE or respiratory protection prevent the body from cooling. Personnel must inform their supervisor when experiencing any signs or symptoms of heat stress or observing a fellow employee experiencing such symptoms.

Heat stress stay times will be documented by the IH on the appropriate work control document(s); that is, an SWP, prejob briefing form, or other when personnel wear PPE that may increase heat body burden. These stay times will take into account the amount of time spent on a task, the nature of the work (i.e., light, moderate, or heavy), type of PPE worn, and ambient work temperatures. Table 2-6 lists heat stress signs and symptoms of exposure.

Individuals showing any of the symptoms of heat exhaustion listed in Table 2-6 shall do the following:

- Stop work
- Exit or be helped from the work area
- Remove and decontaminate PPE (as applicable)
- Move to sheltered area to rest
- Be provided cool drinking water
- Be monitored by a medic or employee certified in cardiopulmonary resuscitation (CPR) and first-aid.

Monitoring for heat stress conditions shall be performed in accordance with MCP-2704 (2002). Depending on the ambient weather conditions, work conditions, type of PPE worn, and the physical response of work operations personnel, the IH shall inform the field supervisor or RCT of necessary adjustments to the work and rest cycle. Additionally, physiological monitoring may be conducted to determine if personnel are replenishing liquids fast enough. A supply of cool drinking water will be provided in designated eating areas and consumed only in these areas. Project personnel may periodically be interviewed by the IH, RCT, or safety professional to ensure that the controls are effective and that

excessive heat exposure is not occurring. Workers will be encouraged to monitor personal body signs and to take breaks if symptoms of heat stress occur.

Table 2-6. Heat stress signs and symptoms of exposure.

Heat-Related Illness	Signs and Symptoms	Emergency Care
Heat rash	Red skin rash and reduced sweating.	Keep the skin clean, change all clothing daily, and cover affected areas with powder containing cornstarch or with plain cornstarch.
Heat cramps	Severe muscle cramps and exhaustion, sometimes with dizziness or periods of faintness.	Move the patient to a nearby cool place; give the patient half-strength electrolytic fluids; if cramps persist, or if signs that are more serious develop, seek medical attention.
Heat exhaustion	Rapid, shallow breathing; weak pulse; cold, clammy skin; heavy perspiration; total body weakness; dizziness that sometimes leads to unconsciousness.	Move the patient to a nearby cool place, keep the patient at rest, give the patient half-strength electrolytic fluids, treat for shock, and seek medical attention. DO NOT TRY TO ADMINISTER FLUIDS TO AN UNCONSCIOUS PATIENT.
Heat stroke	Deep, then shallow, breathing; rapid, strong pulse, then rapid, weak pulse; dry, hot skin; dilated pupils; loss of consciousness (possible coma); seizures or muscular twitching.	Cool the patient rapidly. Treat for shock. If cold packs or ice bags are available, wrap them and place one bag or pack under each armpit, behind each knee, one in the groin, one on each wrist and ankle, and one on each side of the neck. Seek medical attention as rapidly as possible. Monitor the patient's vital signs constantly. DO NOT ADMINISTER FLUIDS OF ANY KIND.

Note: Heat exhaustion and heat stroke are extremely serious conditions that can result in death and should be treated as such. The shift supervisor should immediately request an ambulance (777 or 526-1515) be dispatched from the Central Facilities Area (CFA) -1612 medical facility and the affected individual cooled as described above in Table 2-6 based on the nature of the heat stress illness.

2.3.2.2 Low Temperatures and Cold Stress. For outdoor project-support operations, personnel will be exposed to low temperatures during fall and winter months or at other times of the year if relatively cool ambient temperatures combine with wet or windy conditions. The IH will be responsible for obtaining meteorological information to determine if additional cold stress administrative controls are required. Appendices B and C of MCP-2704 (2002) discuss the hazards and monitoring of cold stress. Table 2-7 provides the cold stress work and warm-up schedule if cold stress conditions exist (late fall, winter, early spring).

Additional cold weather hazards may exist from working on snow- or ice-covered surfaces. Slip, fall, and material-handling hazards are increased under these conditions. Every effort must be made to ensure walking surfaces are kept clear of ice. The assigned project safety professional should be notified immediately if slip or fall hazards are identified at any project location.

Table 2-7. Cold stress work and warm-up schedule.

Air Temperature °F (Approximate)	No Noticeable Wind		Wind 5 mph		Wind 10 mph		Wind 15 mph		Wind 20 mph	
	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks	Maximum Work Period	Number of Breaks
-15 to -19	Normal breaks	1	Normal breaks	1	75 minutes	2	55 minutes	3	40 minutes	4
-20 to -24	Normal breaks	1	75 minutes	2	55 minutes	3	40 minutes	4	30 minutes	5
-25 to -29	75 minutes	2	55 minutes	3	40 minutes	4	30 minutes	5	Nonemergency work should cease	
-30 to -34	55 minutes	3	40 minutes	4	30 minutes	5	Nonemergency work should cease			
-35 to -39	40 minutes	4	30 minutes	5	Nonemergency work should cease					
-40 to -44	30 minutes	5	Nonemergency work should cease							
-45 and below	Nonemergency work should cease									

2.3.2.3 Ultraviolet Light Exposure. Personnel will be exposed to ultraviolet light (UV) (i.e., sunlight) when conducting project operations outdoors. Sunlight is the main source of UV known to damage the skin and to cause skin cancer. The amount of UV exposure depends on the strength of the light, the length of exposure, and whether the skin is protected. No UV rays or suntans are safe. The following are mitigative actions that should be taken to minimize UV exposure:

- Wear clothing to cover the skin (long pants [no shorts] and long-sleeve or short-sleeve shirt [no tank tops])
- Apply a sunscreen with a sun protection factor of at least 15 to areas exposed to the sun
- Wear a hat (hard hat where required)
- Wear UV-absorbing safety glasses
- Limit exposure during peak intensity hours of 10 a.m. to 4 p.m. whenever possible.

2.3.3 Confined Spaces

Entry inside the gloveboxes has been identified as a confined space entry in the OU 7-10 project operations area. Work in confined spaces can subject personnel to risks involving engulfment, entrapment, oxygen deficiency, and toxic or explosive atmospheres. If confined spaces are identified at the OU 7-10 project area, they will be evaluated in accordance with MCP-2749 (2002), "Confined Spaces," to determine if they are permit-required. If entry into identified project confined spaces is required, then all requirements of MCP-2749 (2002) will be followed.

2.3.4 Biological Hazards

The project facilities and support buildings and structures provide habitat for various rodents, insects, and vectors (i.e., organisms that carry disease-causing microorganisms from one host to another). The potential exists for encountering nesting materials or other biological hazards and vectors. Hantavirus may be present in the nesting and fecal matter of deer mice. If such materials are disturbed, it can become airborne and create a potential inhalation pathway for the virus. Contact and improper removal of these materials may provide additional inhalation exposure risks.

If suspected rodent nesting or excrement material is encountered, the assigned IH will be notified immediately and **no attempt will be made to remove or to clean the area**. Following an evaluation of the area, disinfection and removal of such material will be conducted in accordance with MCP-2750 (2002), "Preventing Hantavirus Infection."

Snakes, insects, and arachnids (e.g., spiders, ticks, and mosquitoes) also may be encountered at the project. Common areas to avoid include material stacking and staging areas, under existing structures (e.g., trailers and buildings), under boxes, and other areas that provide shelter. Protective clothing will generally prevent insects from direct contact with the skin. If potentially dangerous snakes or spiders are found or are suspected of being present, warn others, keep clear, and contact the assigned IH for additional guidance as required.

Insect repellant (DEET or equivalent) may be required. Areas where standing water has accumulated (e.g., evaporation ponds) provide breeding grounds for mosquitoes and should be avoided. In cases where a large area of standing water is encountered, it may be necessary to pump the water out of the declivity (areas other than the established SDA ditches and silt basin).

2.3.5 Inclement Weather Conditions

When inclement or adverse weather conditions develop that may pose a threat to persons or property at the project area (e.g., sustained strong winds 25 mph or greater, electrical storms, heavy precipitation, or extreme heat or cold) these conditions will be evaluated and a decision made by the IH, safety professional, RCT, and other operations personnel, as appropriate, to stop work, employ compensatory measures or proceed with operations. The shift supervisor and operations personnel shall comply with INEEL MCPs and facility work control documents and design requirements that specify limits for project operations.

During all project activities, assigned health and safety professionals in consultation with RadCon and the shift supervisor will determine if wind or other weather conditions pose unacceptable hazards to personnel or the environment.

2.4 Other Project Hazards

Project personnel should continually look for potential hazards and immediately inform the shift supervisor or other operations lead personnel of the hazards so that action can be taken to correct the condition. All personnel have the authority to initiate STOP WORK actions in accordance with MCP-553 (2001), "Stop Work Authority," if it is perceived that an imminent safety or health hazard exists or take corrective actions within the scope of the work control authorization documents to correct minor safety or health hazards and then inform the shift supervisor.

Personnel working at the project are responsible to use safe-work practices, report unsafe working conditions, near misses or acts, and exercise good housekeeping habits during project operations with respect to tools, equipment, and waste.

2.5 Site Inspections

The shift supervisor, IH, safety professional, RCT, and operations personnel may participate in project site inspections during the work control preparation stage of the project (e.g., the hazard identification and verification walkdowns), and conduct self-assessments or other inspections. Additionally, periodic safety inspections will be performed by the operations supervisors and assigned health and safety professionals in accordance with MCP-3449 (2001), "Safety and Health Inspections."

Targeted or required self-assessments will be performed during project operations in accordance with MCP-8 (2002), "Self-Assessment Process for Continuous Improvement," as directed by the operations manager or shift supervisor. All inspections and assessments will be documented and available for review by the shift supervisor, as a minimum. Health and safety professionals present during project operations may, at any time, recommend changes in work habits to the shift supervisor. However, all changes that may affect the facility written work control documents (e.g., HASP, JSAs, RWPs, SWPs, and work orders) must have concurrence from the appropriate operations technical discipline representative onsite and a Form 412.11 (2001), "Document Management Control Systems (DMCS) Document Action Request (DAR)," prepared for the applicable document as required.

3. EXPOSURE MONITORING AND SAMPLING

The potential for exposure to chemical, radiological, and physical hazards exists during OU 7-10 Glovebox Excavator Method Project operations and will affect all project operations personnel who are involved with operational waste handling, sorting, storage, transporting, and decontamination activities. Refinement of project operational area access requirements, work control zones (see Section 7), use of engineering and administrative controls, worker training, and wearing PPE provide the mitigation strategy for these hazards. Monitoring and sampling will be used throughout project operations to (1) assess the effectiveness of engineering controls, (2) determine the appropriate PPE requirements for individual tasks, and (3) determine the need for upgrading and downgrading of PPE as described in Section 5. Monitoring with direct-reading, stationary, and mobile instruments will be conducted to provide RadCon and Industrial Hygiene personnel with real-time and trending data to assess the effectiveness of control measures.

Tables provided in this section present the strategy for conducting exposure monitoring and sampling. These include:

- Table 3-1: Tasks and hazards to be monitored and monitoring instrument category
- Table 3-2: Monitoring instrument category and description
- Table 3-3: Action levels and associated responses for specific hazards.

3.1 Airborne Exposure Engineering Controls

Radiological engineering controls and isolation features designed for the WMF-671 WES, RCS, and PGS will serve as the primary defense to control both radiological and nonradiological hazards. Specifically, the ventilation system ensures that confinements are maintained during personnel or equipment accesses to the RCS and during an accidental breach of confinement contingency.

The project ventilation system design is a once-through system that ensures airflow is from the cleanest to the most contaminated confinement zones. The airflow is from the outside environment through the WMF-671 WES; from the WMF-671 WES through the PGS gloveboxes, drum loadout enclosures, and RCS; and then from the RCS through the exhaust filter bank and stack.

A primary fan and a manually activated backup fan are located outside the WMF-671 WES at the exhaust stack. Both fans are capable of drawing air from outside the WMF-671 WES through an inlet filter structure and damper in the ceiling of the WMF-671 WES. Air is then drawn through a series of inlet filters and dampers in the personnel monitoring and access rooms, RCS, PGS, drum loadout enclosures, and through the exhaust filter bank and stack. A fan in the transfer area draws air from outside the WMF-671 WES through a filtered inlet.

The exhausted air is monitored by a shrouded probe that meets ANSI and Health Physics Society standard ANSI/Health Physics Society N13.1-1999, "Sampling Airborne Radioactive Materials in Nuclear Facilities" (ANSI 1999). The probe system consists of (1) lines from the stack for collecting real time and recording samples of conditions in the stack, (2) a climate-controlled cabinet for storing radiological samples, and (3) monitoring instrumentation. Real-time samples are analyzed by the system and returned to the stack. Record samples are retained for analysis.

Table 3-1. Tasks and hazards to be monitored, frequency, and monitoring instrument category.

Tasks	Hazard(s) to be Monitored[a]	Instrument Category to be Used
Excavation Operations (RCS)		
• Overburden removal • Waste retrieval • Underburden sampling • Sample handling and transportation	Ionizing radiation—(alpha, beta, gamma, criticality)	1
	Radionuclide contamination—(alpha, beta, gamma)	2
	Chemical and nonradiological constituents, hazardous atmospheres	3, 4
	Respirable dust—silica and other particulates of concern	3, 5
	Hazardous noise	6
	Ergonomics, repetitive motion, lifting	7
	Heat and cold stress	8
Glovebox Operations (PGS)		
• Waste packaging • Waste sorting • Waste handling • Drum preparation • Drum loadout	Ionizing radiation—(alpha, beta, gamma, fissile material)	1
	Radionuclide contamination—(alpha, beta, gamma)	2
	Chemical and nonradiological constituents, hazardous atmospheres	3, 4
	Respirable dusts and other particulates of concern	3,4,5
	Hazardous noise	6
	Ergonomics, repetitive motion, lifting	7
General Project Operational Support Tasks		
• Drum handling • Forklift operations • Waste transportation and storage • Waste inspections • Drum assay	Ionizing radiation—(alpha, beta, gamma)	1
	Radionuclide contamination—(alpha, beta, gamma)	2
	Chemical constituents—organic vapors, lead	3, 4
	Respirable dust—silica (area and personal)	3, 5
	Hazardous noise	6
	Ergonomics, repetitive motion, lifting	7
	Heat and cold stress	8

Table 3-1. (continued).

Tasks	Hazard(s) to be Monitored[a]	Instrument Category to be Used
Maintenance of Project Systems		
• Electrical • Piping, valves, fittings, hoses • Communication • Heating, ventilating • Mechanical equipment	Ionizing radiation—(alpha, beta, gamma)	1
	Radionuclide contamination—(alpha, beta, gamma)	2
	Respirable dust—silica (area)	4, 5
Decontamination Tasks		
• Operational tools and equipment • RCS and PGS preliminary decontamination	Ionizing radiation—(alpha, beta, gamma)	1
	Radionuclide contamination—(alpha, beta, gamma)	2
	Respirable dust—silica (area and personal)	4, 5
	Hazardous noise	6
	Ergonomics, repetitive motion, lifting	7
	Heat and cold stress	8
Facility Lay-up		
• Backfill excavation • Fix removable contamination • Final decontamination on RCS and PGS • Secure WMF-671 WES	Radionuclide contamination—(alpha, beta, gamma)	2
	Chemical constituents—organic vapors, lead, cadmium	3, 4
	Hazardous noise	6
	Ergonomics, repetitive motion, lifting	7
	Heat and cold stress	8

a. Monitoring and sampling will be conducted as deemed appropriate by project Industrial Hygiene and RadCon personnel based on specific tasks and site conditions.

OU = operable unit
PGS = Packaging Glovebox System
RadCon = Radiological Control
RCS = Retrieval Confinement Structure
WES = Weather Enclosure Structure

Table 3-2. Monitoring instrument category and description.

Instrument Category	Instrument Category Number Description[a]
1	**Alpha:** Count rate—Bicron/NE Electra (DP-6 or AP-5 probe) or equivalent. Stationary—Eberline RM-25 (HP-380AB or HP-380A probe) or equivalent. **Beta-gamma:** Count rate—Bicron NE/Electra (DP-6, BP-17 probes) or equivalent. Stationary—Eberline RM-25 (HP-360AB probe) or equivalent. Criticality alarm system Fissile material monitor
2	CAM (alpha)—ALPHA 7-A-1 (in-line and radial sample heads, pump, RS-485) or equivalent (as required). CAM (beta)—AMS-4 (in-line and radial head, pump RS-485) or equivalent (as required). Grab sampler—SAIC H-810 or equivalent.
3	**Organic vapor:** Direct reading instruments (photoionization detector, flame ionization detector, or infrared detector) detector tubes or grab samples. **Dust:** Direct-reading instrument (miniram).
4	**Organic vapors and other airborne constituents, particulate or hazardous atmospheres:** Personal sampling pumps with appropriate media for partial and full period sampling using NIOSH or OSHA-validated methods, direct reading instruments, or remote sensing detectors.
5	**Silica dust, respirable:** NIOSH 7500 or equivalent, personal sampling pump, 10-mm cyclone, full-period sampling.
6	ANSI Type S2A sound level meter or ANSI S1.25-1991 (ANSI 1991) dosimeter (A-weighted scale for time-weighed average dosimetry, C-weighted for impact dominant sound environments).
7	Observation and ergonomic assessment of activities in accordance with MCP-2692 (2002) Ergonomic Program," and ACGIH TLV.
8	**Heat stress:** wet-bulb globe temperature, body weight, and fluid intake. **Cold stress:** ambient air temperature, wind chill charts.

a. Equivalent instrumentation other than those listed may be used.

ACGIH = American Conference of Governmental Industrial Hygienists ANSI = American National Standards Institute
CAM = constant air monitor MCP = management control procedure
OSHA = Occupation Safety and Health Administration NIOSH = National Institute for Occupational Safety and Health
SAIC = Science Applications International Corporation TLV = threshold limit value

Table 3-3. Action levels and associated responses for project operational hazards.

Contaminant or Agent Monitored	Action Level	Response Taken If Action Level is Exceeded
Nonradiological nuisance particulates (not otherwise classified)	>10 mg/m^3 (inhalable fraction) >3 mg/m^3 (respirable fraction)	1. Substitute equipment or change method to reduce emissions at source 2. Verify engineering control operation (where in place) or institute engineering controls 3. Evaluate air movement (wind) conditions and reschedule tasks or reposition personnel to upwind position of source 4. Move operation to alternant location (with engineering controls if possible) 5. Use wetting or misting methods to minimize dust and particulate matter 6. IF wetting or misting methods prove ineffective, THEN don respiratory protection[a] (as directed by IH).
Nonradiological airborne contaminant (chemical, dust fume, fiber or particulate)	Based on individual contaminant exposure limit (ACGIH TLV or OSHA PEL) and 29 CFR 1910 (2002) or 1926 substance-specific requirements. Generally, sustained levels at the TLV or PEL in the worker's breathing zone for two minutes should be used as action limit. Where ceiling values or OSHA substance-specific action limit exists, use these values.	1. Substitute equipment or change method to reduce emissions at source 2. Verify engineering control operation (where in place) or institute engineering controls 3. Evaluate air movement (wind) conditions reschedule tasks or reposition personnel to upwind position of source 4. Move operation to alternant location (with engineering controls if possible) 5. IF engineering and administrative controls do not control contaminant below exposure limit, THEN reevaluate engineering and administrative controls or don respiratory protection[a] (as directed by IH) 6. IF OSHA substance-specific standard action limit is exceeded, THEN initiate applicable medical surveillance requirements.

Table 3-3. (continued).

Contaminant or Agent Monitored	Action Level	Response Taken If Action Level is Exceeded
Nonradiological hazardous atmosphere Chemical IDLH, oxygen deficient, oxygen enriched, 10% of chemical LEL	As defined by MCP-2749 (2002), confined spaces are based on criteria such as oxygen level, individual contaminant IDLH value, and LEL. **Note**: *No entry into an area or space containing a hazardous atmosphere is permitted without the authorization of the project operations manager, or representative, in conjunction with health and safety professionals This authorization will be demonstrated through the use of approved operational procedures or other work control documents.*	1. Eliminate hazardous atmosphere through use of engineering controls. 2. Reschedule operations when area or space will not have hazardous atmosphere. 3. Evaluate space or area to be entered. IF the operation can be conducted outside the area or space, THEN perform operation without entry. 4. Measure atmosphere before initiating operation or personnel entry and verify acceptable entry conditions have been met (e.g., oxygen and LEL) and use engineering controls to maintain safe atmosphere and below specified exposure limit. Use permit system to authorize entry. 5. IF engineering control fails to control contaminant below safe atmospheric and exposure limit, THEN stop operation and evacuate personnel until safe atmosphere and specified entry conditions can be achieved. 6. IF IDLH atmosphere must be entered, THEN don appropriate air supplied respiratory protection (with escape capacity) and protective clothing[a]. At least one stand-by person dressed in proper PPE must be present for each entrant. **Note**: *The INEEL fire department also must be notified for any area or space entry into an IDLH atmosphere to ensure adequate rescue equipment and resources are in place.*

Table 3-3. (continued).

Contaminant or Agent Monitored	Action Level		Response Taken If Action Level is Exceeded	
Hazardous noise levels	<85 dBA 8-hour TWA or equivalent TWA for 10- or 12-hour exposure.		No action.	
	85 to 114 dBA or equivalent TWA for 10- or 12-hour exposure.		1. Isolate noise source or place sound-absorbing barrier in noise path 2. Hearing protection required to attenuate hazard to below 85 dBA 8-hour TWA or equivalent TWA for 10- or 12-hour exposure (device NRR).	
	(a) >115 dBA	(b) >140 dBA	(a) Isolate source, evaluate NRR for single device, double protection as needed.	(b) Control entry around source and isolate source, only IH approved double hearing protection to be worn.
Radiation field	<5 mrem/hour		No action, no posting required.	
	5 to 100 mrem/hour @ 30 cm (10 CFR 835.603b, "High Radiation Area" [10 CFR 835, 2002])		1. ALARA committee meeting and evaluation of individual workers ALARA goals or doses 2. Prejob planning and dry runs as deemed appropriate 3. Placement of shielding as feasible. Required Posting: Caution, Radiation Area Supplemental Posting: RWP and Personnel Dosimeter Required for Entry Required Training: Radiological Worker I or II training	

Table 3-3. (continued).

Contaminant or Agent Monitored	Action Level	Response Taken If Action Level is Exceeded
	>100 mrem to 500 Rad @ 100 cm (10 CFR 835.603b [10 CFR 835, 2002])	**No entry unless authorized by the project operations manager (or designated alternate), or the project RadCon personnel in conjunction with the radiological engineer.** 1. ALARA committee meeting and evaluation of individual workers ALARA goals or doses 2. Prejob planning and dry runs as deemed appropriate 3. Prejob briefing (as applicable) 4. Placement of shielding as feasible. Required posting: Caution or Danger, High Radiation Area Supplemental posting: Personnel Dosimeter, Supplemental Dosimeter, and RWP Required for Entry[c] Required training: Radiological Worker I (with high radiation area training) or II training
Radionuclide contamination	Removable contamination levels 1 to 100 times the values in Table 2-2 of the INEEL RCM[b] (10 CFR 835.603d, "Airborne Radioactive Area" [10 CFR 835, 2002])	Bioassay submittal (as required) Respiratory protection (as deemed appropriate) Required posting: Caution or Danger, High Contamination Area Supplemental posting: RWP and Protective Clothing Required for Entry Required training: Radiological Worker II training

Table 3-3. (continued).

Contaminant or Agent Monitored	Action Level	Response Taken If Action Level is Exceeded
	Removable contamination levels >100 times the values in Table 2-2 of the INEEL RCM[b] (10 CFR 835.603d [10 CFR 835, 2002])	**No entry unless authorized by the project operations manager (or designated alternate), or the project RadCon manager in conjunction with the radiological engineer.** 1. ALARA committee meeting and evaluation of individual workers ALARA goals or doses 2. Prejob planning and dry runs as deemed appropriate 3. Prejob briefing 4. Supplied breathing air (as deemed appropriate) Bioassay submittal (as required). Required Posting: Caution or Danger, High Contamination Area Supplemental posting: RWP and Protective Clothing Required for Entry Required training: Radiological Worker II training
Airborne radioactivity	Airborne concentrations (μCi/ml) >30% of and DAC value (10 CFR 835.603d [10 CFR 835, 2002])	**No entry unless authorized by the project operations manager (or designated alternate), or the project RadCon manager in conjunction with the radiological engineer.** 1. ALARA committee meeting and evaluation of individual workers ALARA goals or doses 2. Prejob planning and dry runs as deemed appropriate 3. Prejob briefing 4. Supplied breathing air. Bioassay submittal and lung count (as deemed appropriate) Required posting: Caution, Contamination Area Supplemental posting: RWP and Protective Clothing Required for Entry Required Training: Radiological Worker II training

Table 3-3. (continued).

Contaminant or Agent Monitored	Action Level	Response Taken If Action Level is Exceeded
Response to abnormal radiological conditions or alarms	Supplemental radiation dosimetry or area radiation monitor alarm	1. Stop work activities and place the area in a safe condition (i.e., secure excavator equipment, terminate activities that may result in more severe conditions) 2. Alert others 3. Affected individuals exit the area 4. Notify RadCon personnel.
	PCM alarm	1. Remain in the immediate area 2. Notify RadCon personnel 3. Take actions to minimize cross-contamination (e.g., putting a glove on a contaminated hand) 4. Take follow-up actions in accordance with Article 541 of the INEEL RCM Article 541 (PRD-183 2000).
	CAM alarm	1. Stop work activities and place the area in a safe condition (i.e., secure excavator equipment, terminate activities that may result in more severe conditions) 2. Warn others in area and exit the area 3. Notify RadCon personnel.
	Spill of radioactive material	1. Stop or secure the operation causing the spill[d] 2. Warn others in the area 3. Isolate the spill area if possible 4. Minimize individual exposure and contamination 5. Secure unfiltered ventilation 6. Notify RadCon personnel.

Table 3-3. (continued).

Contaminant or Agent Monitored	Action Level	Response Taken If Action Level is Exceeded
	Criticality alarm	1. Immediately evacuate the area, without stopping to remove protective clothing or perform exit monitoring 2. Report to designated assembly area.
	Fissile material monitor set point alarm or 200 FGE indicator	1. Identify source of high FGE material 2. Notify RadCon personnel 3. Take corrective actions to separate or split high FGE material into two or more containers of less than 200-g FGE 4. Maintain critically safe storage configuration in accordance with limiting condition for operation.
Other facility or INEEL alarms	Project operations, RWMC or INEEL alarm	See Section 10.6 for emergency response action following facility or INEEL alarms.

a. Respiratory protection and clothing as prescribed by the project IH and RadCon personnel (based on contaminant of concern). See Section 5 for additional PPE requirements.
b. *Manual 15A—Radiation Protection—INEEL Radiological Control Manual* (PRD-183 2000).
c. Access requirements may be deleted or modified if personnel access is specifically prohibited.
d. For radioactive spills involving highly toxic chemicals, workers should immediately exit the area without attempting to stop or secure the spill. They should then promptly notify the IH or INEEL HAZMAT team and Project RadCon personnel.

ACGIH = American Conference of Governmental Industrial Hygienists
ALARA = as low as reasonably achievable
CAM = constant air monitor
CFR = *Code of Federal Regulations*
DAC = derived air concentration
FGE = fissile gram equivalent
HAZMAT = hazardous material
IDLH = immediately dangerous to life or health
IH = Industrial Hygiene
INEEL = Idaho National Engineering and Environmental Laboratory
LEL = lower explosive limit
NRR = noise reduction rating
OSHA = Occupational Safety and Health Administration
OU = operable unit
PCM = personal contamination monitor
PEL = permissible exposure limit
RadCon = Radiological Control
RCM = Radiological Control Manual
RWMC = Radioactive Waste Management Complex
TLV = threshold limit value
TWA = time-weighted average

3.2 Exposure Limits

Only limited entry into the RCS is anticipated (e.g., during overburden removal tasks, to stage equipment, and for repairs). Exposure limits identified in Table 3-3 serve as the initial action limits for specific project operations and contaminants. RadCon and Industrial Hygiene personnel will conduct initial and periodic monitoring of project operations with direct-reading instruments and stationary monitors, collect swipes, and conduct full- and partial-period air sampling, as deemed appropriate, in accordance with applicable TPRs, MCPs, and other guidelines. As new project processes or hazards are introduced, each will be evaluated and controlled in accordance with PRD-25 (1999). Action limits should be adjusted as required based on changing site conditions, exposure mitigation practices, and PPE levels. Such changes will be reflected in applicable work control documents, permits, and procedures.

3.3 Environmental and Personnel Monitoring

The potential for exposure to radiological and nonradiological hazards exists during project operations. All project operations personnel who handle, store, transport, and conduct disposal or decontamination activities will be protected from radiological and nonradiological contaminants to the extent feasible through the use of engineering controls, work controls, and PPE. However, the potential for exposure to these contaminants cannot be eliminated. Environmental and personnel monitoring will be conducted to determine the effectiveness of these exposure control practices and assist health, safety, and radiological professionals in establishing additional administrative controls and PPE requirements.

Industrial Hygiene and RadCon personnel will conduct monitoring with direct reading instrumentation, collect contamination control swipes, and conduct full- and partial-period air sampling during project operations in accordance with applicable MCPs, OSHA substance-specific standards, and as stated on project operational RWPs. Instrumentation listed on Table 3-1 (or equivalent) will be selected based on the Site-specific conditions and contaminants associated with OU 7-10 project tasks. The RCT and IH will be responsible for determining the best monitoring technique for radiological and nonradiological contaminants (respectively). Safety hazards and other physical hazards will be monitored and mitigated as outlined in Section 2.

3.3.1 Industrial Hygiene Area and Personal Monitoring and Instrument Calibration

The assigned OU 7-10 project IH will conduct full- and partial-period sampling of airborne contaminants and monitoring of physical agents during operations at a frequency deemed appropriate based on direct-reading instrument readings and changing conditions. When performed, all air sampling will be conducted using applicable National Institute of Occupational Safety and Health (NIOSH), OSHA, or other validated method. Both personal and area sampling and remote sensing monitoring may be conducted.

Various direct-reading instruments may be used to determine the presence of nonradiological and other physical agents. The frequency and type of sampling and monitoring will be determined by OU 7-10 project operations conditions, direct-reading instrument results, observation, professional judgment, and in accordance with the MCP-153 (2002), "Industrial Hygiene Exposure Assessment."

All monitoring instruments will be maintained and calibrated in accordance with the manufacturer's recommendations, existing IH protocol, and in conformance with MCP-2391 (2001), "Calibration Program," and in conformance with the companywide safety and health manuals, *Manual 14A—Safety and Health, Occupational Safety, and Fire Protection* (INEEl 2002a) and *Manual 14B—Safety and Health Occupational, Medical, and Industrial Hygiene* (INEEL 2002b). Calibration

information, sampling and monitoring data, results from direct-reading instruments, and field observations will be recorded as stated in Section 12.

3.3.2 Radiological Monitoring and Instrument Calibration

Radiological instrumentation to be used during OU 7-10 project operations will include alpha and beta-gamma CAMs positioned in strategic locations identified by RadCon personnel. Stationary beta-gamma and alpha self-survey instruments for hand monitoring will be located in close proximity to all gloveports. Radiation area monitors will be centrally located to identify any high radiation source when it is uncovered in the retrieval area or in a glovebox. The PCMs for automated whole-body survey will be located at normal egress points. Additionally, scalers, high-volume samplers, lapel samplers, and other instrumentation will be available to collect and quantify radiological contamination levels.

In addition to these routine radiological monitoring and sampling instruments and equipment, other instrumentation provided for project operations will include a criticality alarm system (CAS) and fissile material monitoring system. The CAS detectors are set to alarm at 100 mrem/hour. The CAS will alarm on a high radiation (high alarm) condition or on a loss of signal (low alarm). An alarming CAS would cause an evacuation of personnel within the WMF-671 WES and from areas surrounding the WMF-671 WES.

Radiological monitoring of radiation and contamination will be conducted during OU 7-10 project operations to ensure that personnel are given adequate protection from potential radiological exposure. Instruments and sampling methods listed in Table 3-2 may be used by the RCT as deemed appropriate and as required by general or task-specific RWPs. When conducted, monitoring will be performed in accordance with *Manual 15B—Radiation Protection Procedures* (INEEL 2002c) and *Manual 15C—Radiological Control Procedures* (INEEL 2002d). The data obtained from monitoring will be used by RadCon personnel to evaluate the effectiveness of OU 7-10 project engineering controls, decontamination methods and procedures, and to alert personnel to potential radiation sources.

All portable survey instruments will be source-checked daily to ensure they are within the specified baseline calibration limits. Accountable radioactive sources will be maintained in accordance with MCP-137 (2002), "Radioactive Source Accountability and Control." All radiological survey and monitoring equipment will be maintained and calibrated in accordance with the manufacturer's recommendations, existing RadCon protocol, in accordance with companywide *Manual 15B* (INEEL 2002c) and in conformance with MCP-93 (1999), "Health Physics Instrumentation."

3.3.3 Fissile Material Monitoring

The fissile material monitoring system is used to monitor the accumulation of fissile materials in new waste drums during the drum loadout process. Waste types requiring fissile monitoring are listed below:

- Intact HEPA filters
- HEPA filter media
- Materials not distinguishable from HEPA filter media
- Intact graphite molds and large chunks of graphite molds (i.e., pieces greater than 2 in. in diameter)
- Other containerized unknown waste materials with potential of having unsafe masses of plutonium.

These waste types may not undergo fissile monitoring if new data becomes available that indicates that the actual drum loadings are less than 200 g.

A drum assay station will be set up to ensure to ensure the following drum loading and storage requirements are met:

- Fissile-loading limits of 200 g per drum
- More than 380-g FGE per drum for criticality safety fissile material content (drum spacing and handling).

Any established assay station or system will be adequately shielded and equipped with interlocks to prevent exposure to assay operators.

3.3.4 Personnel Radiological Exposure Monitoring

Personal radiological monitoring will be conducted during OU 7-10 project operational activities to quantify radiation exposure and potential for uptakes as stated in the general or task-specific RWP. This will include the use of external dosimetry, surface monitoring, and internal dosimetry methods to ensure that engineering controls, administrative controls, and work practices are effectively mitigating radiological hazards. General as low as reasonably achievable (ALARA) considerations are discussed further in Section 4.4.

3.3.4.1 External Dosimetry. Dosimetry requirements will be based on the radiation exposure potential during OU 7-10 project operations. All personnel who enter OU 7-10 project operational areas will be required to wear a minimum of a thermoluminescent dosimeter (TLD) and other personal dosimetry devices (e.g., albedo dosimetry) specified by RadCon personnel, in applicable RWPs, and in accordance with the *Manual 15A—INEEL Radiological Control Manual* (PRD-183 2000).

The Radiological Control and Information Management System (RCIMS) will be used to track external radiation exposures to OU 7-10 project personnel and to serve as the administrative control mechanism for working in accordance with individual RWPs. Individual OU 7-10 project personnel are responsible for ensuring all required personal information is provided to RadCon personnel for entry into RCIMS and logging in when electronic dosimeters are used.

3.3.4.2 Internal Monitoring. The purpose of internal dose monitoring is to demonstrate the effectiveness of contamination control practices and to document the nature and extent of any internal uptakes that may occur. Internal dose evaluation programs will be adequate to demonstrate compliance with 10 CFR 835 (2002), "Occupational Radiation Protection." The requirement for whole body counts, lung counts, and bioassays will be based on specific OU 7-10 project operational evaluations conducted by the assigned radiological engineer. Select OU 7-10 project operations personnel will be entered into a plutonium bioassay program based on the hazards associated with individual job functions. Bioassay requirements will be specified on the RWP and OU 7-10 project personnel will be responsible for submitting required bioassay samples upon request.

4. ACCIDENT AND EXPOSURE PREVENTION

The OU 7-10 Glovebox Excavator Method Project operations will present numerous safety, physical, chemical, and radiological hazards to personnel conducting these activities. It is critical that all personnel understand and follow the requirements of this HASP. Project facility design features, engineering controls (confinement), hazard isolation, specialized work practices, and the use of PPE will be in place to eliminate or mitigate all potential hazards and exposures. However, given the nature of the OU 7-10 project scope and the waste material being excavated, all hazards cannot be eliminated. Personnel are responsible for the identification and control of hazards in their respective project work areas in accordance with Integrated Safety Management System (ISMS) principals and practices.

Note: Hazards will not be left unmitigated without implementing some manner of controls or abatement (e.g., engineering controls, administrative controls, or the use of PPE).

Personnel should use stop work authority in accordance with MCP-553 (2001), "Stop Work Authority," where it is perceived that imminent danger to personnel, equipment, or the environment exists.

This HASP is to be used in conjunction with PRD-25 (1999) and OU 7-10 project work authorization and control documents such as STD-101 (2001); work orders; JSAs; MCP-3562 (2001), "Hazard Identification, Analysis, and Control of Operational Activities"; and OU 7-10 project operational technical procedures. Where appropriate, MCP-3562 (2001) and GDE-6212 (2001), "Hazard Mitigation Guide for Integrated Work Control Process," mitigation guidance will be incorporated into applicable work controls, JSAs, and RWPs.

4.1 Voluntary Protection Program and Integrated Safety Management System

Project operations will incorporate Voluntary Protection Program (VPP) and ISMS criteria, principles, and concepts to identify and mitigate hazards, thereby preventing accidents. All management and workers are responsible for implementing safety policies and programs and for maintaining a safe and healthful work environment. Personnel will take a proactive role in preventing accidents, ensuring safe working conditions for themselves and fellow personnel, and complying with all work control documents, procedures, and permits.

The **ISMS** is focused on the **system** side of conducting operations and **VPP** concentrates on the **people** aspect of conducting work. Both programs define work scope, identify and analyze hazards, and mitigate the hazards. The INEEL and its subcontractors participate in VPP and ISMS. This OU 7-10 project operations HASP includes all elements of both systems. The five key elements of VPP and ISMS and their corresponding HASP sections are as shown in Table 4-1.

4.2 General Safe-Work Practices

Sections 1 and 2 defined the OU 7-10 project scope of work and associated operations-specific hazards and mitigation. Section 3 provided the exposure monitoring and sampling strategy for ensuring the effectiveness of facility safety systems and engineering control. The following general safe-work practices are mandatory for all personnel to further reduce the likelihood of accidents, injuries, and exposures. In addition, all visitors permitted to enter OU 7-10 project operational work areas must follow these requirements. Failure to follow these practices may result in permanent removal from the OU 7-10 project and other disciplinary actions. The OU 7-10 project shift supervisor in conjunction with assigned

health and safety and RadCon personnel will be responsible for ensuring the following safe-work practices are adhered to OU 7-10 project operations:

Table 4-1. Five key elements of the Voluntary Protection Program and Integrated Safety Management System and corresponding sections of the Operable Unit 7-10 project health and safety plan.

Voluntary Protection Program	Integrated Safety Management System	Project Operations Health and Safety Plan Section
Work site analysis	Define work scope	Section 1
	Analyze hazards	Sections 2, 3, 5 and 8
Hazard prevention and control	Develop and implement controls	Sections 2, 3, 4, 5, 7, 10 and 11
Safety and health training	Perform within work controls	Section 6
Employee involvement		Sections 2, 3 and 4
Management leadership	Provide feedback and improvement	Sections 6 and 9

- Limit access to OU 7-10 project operations areas to authorized personnel only, in accordance with PRD-1007, "Work Coordination and Hazards Control."

- Personnel must be aware of and comply with all safety signs, tags, barriers, and color codes as identified in PRD-5117 (2001), "Accident Prevention Signs, Tags, Barriers, and Color Codes."

- Be familiar with the physical characteristics of the OU 7-10 project facilities and operational requirements, including, but not limited to the following:

  - Layout of the WMF-671 WES, controlled areas, and egress routes

  - Project waste types, labeling, and storage requirements

  - Facility safety-significant structures, systems, and components; technical safety requirements; and limiting conditions of operation

  - Facility and RWMC warning devices and alarms

  - Communications with the OU 7-10 project and RWMC shift supervisors

  - Major SDA roads and means of access to and from the OU 7-10 project

  - Location of facility emergency response equipment and first-aid supplies.

- Be alert for dangerous situations (e.g., facility alarms, spills, accidents, and injuries) and report dangerous situations and near misses to the shift supervisor. The shift supervisor will make required notification in accordance with Section 10.

- Provide adequate information to the oncoming shift personnel, including equipment and system status and inspection logs, and communicate all systems, monitors, and safety components that are nonoperational and ensure they are tagged as to their appropriate status (e.g., out-of-service or do not use).

- Plan and review all operational tasks before initiating the activity. Verify all work control documents (e.g., the RWP, JSA, technical procedure [TPR], or work order) are current and correct for the activity. A prejob briefing is required to be conducted for all activities in accordance with MCP-3003 (2001), "Performing Prejob Briefings and Post-Job Reviews."

- Conduct all OU 7-10 project operations in accordance with the applicable TPR or work order. All operational activities will be conducted as stated in the applicable work control document including hold points and requirements for initials upon completion of certain steps (use Type 1 TPR only) or work orders. Use Type 2 TPRs will be followed in a step-by-step sequence.

Note: It is the responsibility of all operations personnel to identify, understand, and follow the appropriate work controls for their operational activities.

- All personnel shall have the authority to initiate STOP WORK actions in accordance with MCP-553 (2001), "Stop Work Authority."

- Personnel shall be familiar with OU 7-10 project facility tools and equipment for which they are responsible to operate including operating limitations, maintenance, inspection, and manufacturer's operating instructions requirements. Tools and equipment shall only be used for their intended use.

- Understand the PPE requirements for all tasks as stated on the applicable JSA or work order. This includes the proper use and limitation of all PPE. If questions arise about PPE, contact the assigned IH, safety professional, or RCT as applicable.

- Personnel must wear all required dosimetry as stated on the RWP. This includes any supplemental dosimetry (e.g., electronic dosimeters and albedo dosimeters). Respond to all radiological alarms including but not limited to CAMs, criticality system, radiation, and PCM alarms.

- Avoid direct contact with OU 7-10 project waste material or containers. Personnel shall not walk through spills or other areas of contamination and shall avoid kneeling, leaning, or sitting on equipment or surfaces that may be contaminated.

- Personnel shall not eat, drink, chew gum or tobacco, smoke, apply cosmetics or sunscreen, or perform any other practice that increases the probability of hand-to-mouth transfer and ingestion of materials in OU 7-10 project operations areas, except within designated administrative break areas and only after having completed required contamination surveys.

- Practice good housekeeping at all times. Turn in or place tools in the designated storage location after use. Put waste materials in the appropriate waste container or receptacle. If there is a question as to where to dispose of a waste article, personnel should ask the supervisor or the shift supervisor.

- Additional health, safety, and radiological requirements will be identified in OU 7-10 project operations technical procedures and work packages.

4.3 Subcontractor Responsibilities

Where subcontractors are used to support OU 7-10 project operations, subcontractors are responsible for meeting all applicable INEEL MCP, PRD, VPP, and ISMS flow-down requirements such as those listed on the completed INEEL Form 540.10, "Checklist for Subcontractor Requirements for On-Site Nonconstruction Work"; *Subcontractor Requirements Manual* (INEEL 2002e); and contract

general and special conditions. Additionally, subcontractors are expected to take a proactive role in hazard identification and mitigation while conducting operational support tasks. Subcontractors will report unmitigated hazards to the OU 7-10 project shift supervisor after taking protective actions (within the documented work controls) and emergency protective actions.

4.4 Radiological and Chemical Exposure Prevention

The OU 7-10 project operational facilities (i.e., RCS and PGS) have been designed to minimize exposure to personnel from the radiological and chemical contaminants in OU 7-10 during excavation and glovebox operations. The concept of defense-in-depth has been applied to protect personnel from the most significant hazards and provide additional barriers, engineering controls, access restrictions, and administrative controls to abate radiological and chemical exposure to personnel. Where entry into contaminated areas is required, chemical, radiological, and physical hazards will be mitigated through the use of work procedures and hold points, area and personnel monitoring, and PPE where possible or to minimize them where engineering controls are not feasible. All personnel are responsible for understanding the hazard identification and mitigation measures necessary to prevent or reduce exposures. This section presents radiological and chemical exposure prevention strategies for use where engineering controls are not feasible and as good work practices.

4.4.1 Radiological Exposure Prevention—As Low as Reasonably Achievable Principles

The radiation exposure of personnel will be controlled such that exposures are well below regulatory limits established in "Occupational Radiation Protection" (10 CFR 835, 2002) and that no radiation exposure occurs without commensurate benefit. All personnel have the responsibility for following ALARA principles and practices.

Note: Unplanned and preventable exposures are considered unacceptable.

The OU 7-10 project shall establish work controls that will ensure that personnel are adequately protected from known sources of radiation in OU 7-10 project operations areas. The issuance of RWPs, establishment and posting of radiological controlled areas, and review of OU 7-10 project operational activities by the RWMC ALARA committee will form the basis for controlling exposure to ionizing radiation during OU 7-10 project operations. Personnel working at the OU 7-10 project must strive to keep both external and internal radiation doses ALARA by adopting the following practices in the following sections.

4.4.1.1 External Radiation Dose Reduction. Sources for external radiation exposure will be primarily from radioisotopes in the OU 7-10 waste (see Table 2-1). Project operational processes have been designed to minimize radiation dose to workers through barriers and shielding in waste excavation and handling areas (i.e., RCS and PGS). Area radiation monitors and criticality system alarms have been installed to alert operations personnel if radiation levels increase in these working areas. Personal supplemental electronic dosimetry will be programmed to alarm at radiation levels much below the area monitors.

The RWPs written for OU 7-10 project operations will define radiological hold points, required dosimetry, RCT coverage, radiological controlled areas, and radiological limiting conditions in accordance with MCP-7 (2002), "Radiological Work Permit." Radiological Control personnel will participate in the prejob briefing required by MCP-3003 (2001) to ensure all personnel understand the

dose rate limits and limiting conditions on the RWP. All personnel will be required to read and acknowledge the RWP requirements before being allowed to sign the RWP (or scan the RWP bar code in the RCIMS) and obtain electronic dosimetry.

Basic ALARA protective measures used to reduce external doses include (1) minimizing time in radiation areas, (2) maximizing the distance from known sources of radiation, and (3) using shielding whenever possible. Specific examples of these methods are provided in the following subsections.

4.4.1.1.1 Methods for Minimizing Time in Radiation Areas—Personnel will incorporate the following methods for minimizing time in radiation areas:

- Preplan all work activities and conduct dry runs where necessary to validate procedures and equipment functional testing
- Plan and discuss the tasks before entering a radiation area (including having all equipment and tools prepared)
- Perform as much work as possible outside radiation areas and take advantage of lower dose rate areas (as shown on the radiological survey maps)
- Take the most direct route to the task area and work efficiently
- Hold technical discussions outside radiation areas if problems occur in the radiation areas, then return to the work area to complete the task
- Know stay time and use appropriate signal and communication method to inform others in the area when the stay time is up, if stay times are required
- Respond to electronic dosimetry alarms by notifying others in the area and the RCT, and exit the radiation area through the designated entry and exit point
- Know individual current dose and dose limit.

Note: If RCIMS indicates an individual is approaching or has exceeded the dose limit, the RCT should be notified immediately and the worker should not proceed into the radiation work area.

4.4.1.1.2 Methods for Maximizing Distance from Radiation Sources—Personnel will incorporate the following methods for maximizing the distance from radiation sources:

- Use remote operated equipment or controls where available
- Stay as far away from the source of radiation as possible (extremely important for point sources where, in general, if the distance between the source is doubled, the dose rate falls to one-fourth of the original dose rate)
- Become familiar with the radiological survey map for the OU 7-10 project operations area where work will be performed, as well as high and low dose-rate locations, and take advantage of low dose-rate areas.

4.4.1.1.3 Proper Use of Shielding—Personnel will incorporate the following methods for the proper use of shielding as a protective measure used to reduce external radiation doses:

- Know what shielding is required and how it is to be used for each radiation source
- Take advantage of the equipment and enclosures for shielding from radiation sources
- Verify interlocks are functional and use shielding when operating drum assay equipment
- Wear safety glasses to protect eyes from beta radiation.

4.4.1.2 Internal Radiation Dose Reduction. The most significant internal radiation dose potential exists during entry into the RCS for manual overburden removal, from repairs, and from routine and unscheduled maintenance activities that may be required (during excavation and waste processing) within the RCS and PGS. An internal dose is a result of radioactive material being taken into the body. Radioactive material can enter the body through inhalation, ingestion, absorption through wounds, or injection from a puncture wound. Reducing the potential for radioactive material to enter the body is critical to avoid an internal dose. The following are methods to minimize the hazard of an internal radiation dose:

- Preplan all work activities and conduct dry runs where necessary to validate procedures and equipment functional testing
- Verify CAMs and other area contamination monitors and samplers are functional before entry into contamination or airborne radioactivity areas
- Review the RadCon survey map for areas of known contamination and potential high contamination sources and minimize or avoid activities in those areas (where possible)
- Wear protective clothing and respiratory protection as identified on the RWP, perform all respirator leak checks, and inspect all PPE before entering contaminated areas or areas with airborne radioactivity
- When inside contaminated areas, do not touch your face (adjust glasses or PPE) or other exposed skin
- Respond to all CAM alarms or other indications of increased contamination levels (RCT directions)
- When exiting contaminated areas, follow all posted instructions and remove PPE in the order prescribed (if questions arise, consult RadCon personnel)
- Conduct whole-body personnel survey when exiting the contaminated area, then proceed directly to the PCM
- Report all wounds or cuts (including scratches and scrapes) before entering radiologically contaminated areas
- Wash hands and face before eating, drinking, smoking, or engaging in other activities that may provide a pathway for contaminants.

Monitoring for radiation and contamination during project tasks will be conducted in accordance with the RWP; PRD-183; companywide *Manuals 15A* (PRD-183 2000), *15B* (INEEL 2002c), *and 15C* (INEEL 2002d); and as deemed appropriate by RadCon personnel.

4.4.2 Chemical and Physical Hazard Exposure Avoidance

Note: Identification and control of exposures to carcinogens will be conducted in accordance with MCP-2703 (2000), "Carcinogens."

The primary potential for exposure to nonradiological contaminants is the same as the radiological sources (i.e., OU 7-10 waste [see Table 2-2]). Additionally, chemicals (e.g., fuels, lubricants, and cleaners) will be used in support of OU 7-10 project operations. A material safety data sheet (MSDS) is required to be available for all chemicals used in accordance MCP-2715 (2002), "Hazard Communication." All chemicals entering the OU 7-10 project must be entered into and tracked using the INEEL Chemical Management System. The INEEL Chemical Management System is used for maintaining and tracking the inventory of chemical containers and basic functionality includes the following:

- Identify container
- Track the location and location changes of a container
- Define the contents of a container at any point in time
- Record distributions into and out of a container
- Record distributions to a waste stream
- Provide a running inventory based on the distributions entered
- Produce regulatory reports from the data entered
- Calculate conversions from one unit of measure to another
- Define container update authorization for a location
- Provide flexibility in how to manage chemicals.

Note: Project waste streams are not considered chemicals for purposes of entry into INEEL Chemical Management System.

Threshold-limit values (TLVs) or other occupation exposure limits have been established for numerous chemicals and physical agents (e.g., noise, heat, or cold stress) that may be encountered. These exposure limits provide guidelines in evaluating airborne, skin, and physical agent exposures. The TLVs represent levels and conditions under which it is believed that nearly all workers may be exposed day after day without adverse health effects. The TLV-time-weighted average (TWA) is a TWA concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse health effects. Action limits (instantaneous concentrations for short time periods) have been established to further reduce the

likelihood of exceeding TLVs or as regulatory triggers for additional medical surveillance and actions. These concentrations for nonradiological contaminants of concern are provided in Table 2-3.

The RCS and PGS have been designed to minimize exposure to personnel from the radiological and chemical contaminants of concern (see Tables 2-1 and 2-2). Design features include a negative pressure HEPA filtered ventilation system, remote waste handling equipment and tools, and double barriers where appropriate. These controls will eliminate or mitigate chemical and physical hazards to a great extent.

Where personnel are required to enter the RCS or PGS during excavation and waste handling activities (e.g., for repairs and routine or unscheduled maintenance), additional exposure monitoring and PPE will be required. Supplied breathing air and protective clothing is available for personnel required to enter contaminated or suspected contaminated areas to perform these tasks. In addition, use of technical procedures and work orders, hold points, training, and monitoring of hazards will be used to reduce exposure potential. Some other exposure minimization methods include the following:

- Preplan all work activities and conduct dry runs where necessary to validate procedures and equipment functional testing
- Wear all required PPE, inspecting all pieces before donning, and taping all seams
- Change PPE if it becomes damaged or shows signs of degrading
- Minimize time in direct contact with hazardous material or waste
- Doff PPE following posted radiological instructions (i.e., rolling outer surfaces in and down) and follow doffing sequence
- Wash hands and face before eating, drinking, smoking, or engaging in other activities that may provide a pathway for contaminants.

Exposure to nonchemical hazards (e.g., hazardous noise) and physical hazards will be controlled through the implementation of existing INEEL MCPs and PRDs in conjunction with the PRD-25 (1999) process. New or previously unidentified hazards shall be reported o the appropriate health, safety, or RadCon personnel.

4.5 Buddy System

The two-person or buddy system will be used during some OU 7-10 project operations. The buddy system is most often used during operational activities requiring the use of protective clothing and respiratory protection where heat stress and other hazards may impede a person's ability to self-rescue or in situations that are IDLH. The buddy system requires each employee to assess and monitor his or her buddy's mental and physical well being during the course of the operation. A buddy must be able to perform the following activities:

- Provide assistance if required
- Verify the integrity of PPE
- Observe his or her buddy for signs and symptoms of heat stress, cold stress, or contaminant exposure
- Notify other personnel in the area if emergency assistance is needed.

The need to use the buddy system during OU 7-10 project operations will be determined by the assigned IH or safety engineer in conjunction with the shift supervisor and RadCon personnel.